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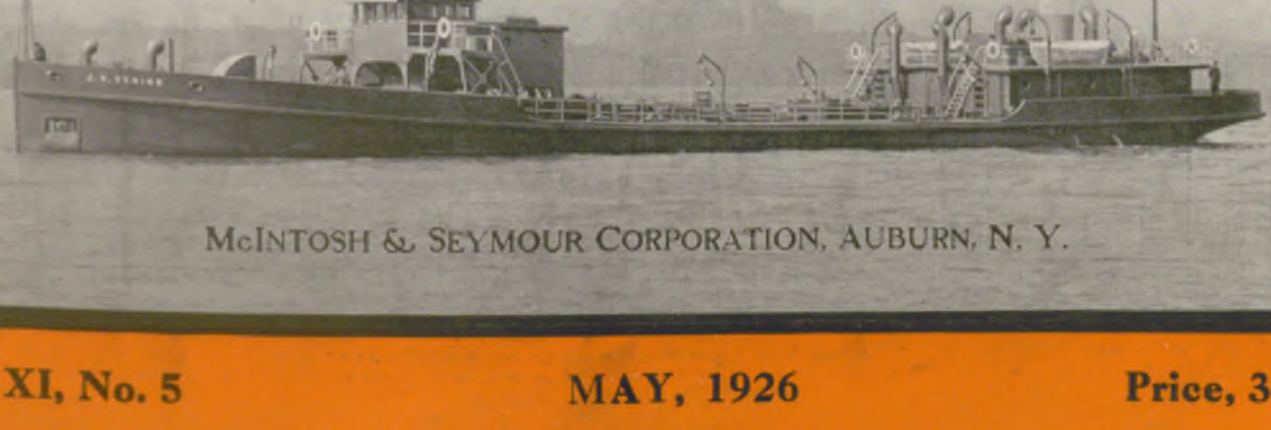
McINTOSH & SEYMOUR DIESEL ENGINES



McINTOSH & SEYMOUR CORPORATION, AUBURN, N. Y.

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ARTICLES on design, construction and operation of oil-engines and motorships by the world's foremost writers on marine engineering.

Motorship

ILLUSTRATIONS of the newest designs in international merchant motorship and Diesel-engine construction and auxiliary equipment.

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Vol. XI May, 1926 No. 5

Diesel Electric Tankers in the Pacific

Standard Oil Company (California) Reports Good Service of Its Three Vessels of This Type, the Standard Service, Alaska Standard and Hawaiian Standard

ABOUT this time last year the Diesel-electric tankship HAWAIIAN STANDARD was commissioned by the Standard Oil Company (California) as a distributing vessel in the Hawaiian Islands. A year and a half previously the ALASKA STANDARD, a tanker of the same type, had been put into service, and six months earlier—in March, 1923—the STANDARD SERVICE, which was the first Diesel-electric tanker owned by the Standard Oil Co. (California) had been placed in operation. All three vessels have been described and illustrated in detail in MOTORSHIP at the time of their commissioning. What the owners think of them was related recently in the *Standard Oil Bulletin,* the monthly house magazine of the company, to which we are indebted for the following article and its illustrations.

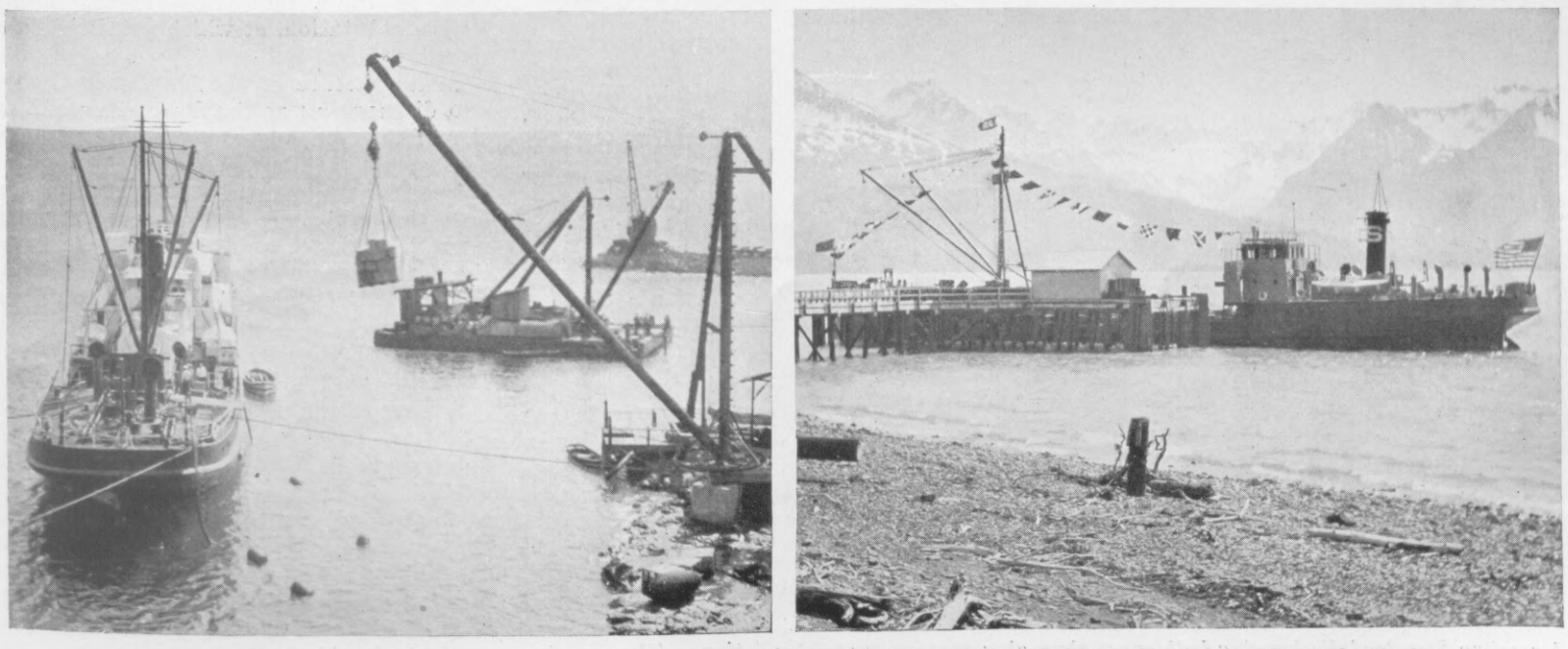
"Well-nigh universal recognition of the advantages of the Diesel engine, particularly as to economy of operation, has resulted in its ever-increasing use in the marine field for both propulsive and auxiliary power. Until the last few years the common application of this prime mover for propulsive power was the so-called direct-Diesel in which the Diesel engine is direct-connected to the propeller shaft.

"Considerable auxiliary power is required by ships for operating cargo winches, refrigerators, and various kinds of pumps serving different purposes, as well as the electric generators which furnish current for lighting purposes. As a majority of this machinery is in operation when the main engines are shut down, an auxiliary source of power is required. In the first Diesel-propelled ships a steam boiler and steam auxiliaries were installed to meet these requirements. It was soon learned that the economy of the main engines was considerably offset by the wasteful use of fuel by the boiler supplying steam for auxiliary power. This led to the installation of smaller Diesel-engine driven generators, which supplied all the power required for light, heat, and motor-driven pumps, refrigerators, cargo winches, etc. This proved to be a forward step, for the Diesel-driven generator supplying auxiliary power was found to be superior in economy and efficiency to the type of steam equipment it displaced.

"All the while the flexibility of electric power, both as to control and utilization, was becoming more and more apparent. Marine engineers and experts in water transportation began to ask themselves the question, 'Why not use electricity for propulsion?' They answered their own question by building ships equipped with steam turbo generators. The U.S.S. CALIFORNIA is a notable example.

"The Standard Oil Company, which pioneered on the Pacific Coast in applying 'direct-Diesel' to ship propulsion, also took the initiative in utilizing 'Diesel-electric' for propelling power; during the month of June, 1922, a contract was placed with the Bethlehem Shipbuilding Corporation for the construction of a Diesel-electric propelled tanker, and in March, 1923, that vessel, the motorship STANDARD SERVICE, was placed in commission.

"The general plans and specifications for this vessel, as well as all electrical equipment, were prepared by our Marine Department, and considerable development work was necessary. The care exercised in the preliminary work, however, was greatly rewarded, as the vessel has proved to be an extremely flexible, highly efficient craft which is handled with unusual ease.



Hawaiian Standard on the left at Kaumalapau, Island of Lanai, and Alaska Standard on the right at Seward, Alaska

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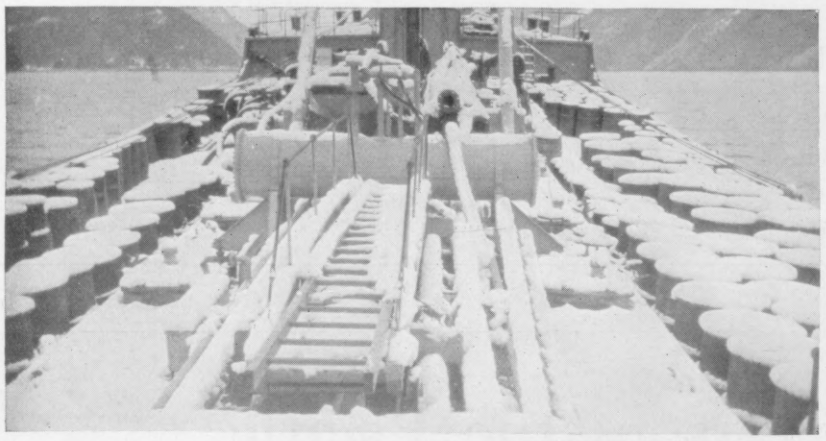


The deck load of Alaska Standard is sometimes augmented en route

"The STANDARD SERVICE is fitted with two Diesel engines, direct-connected to electric generators and exciters which supply power for an electric motor direct-connected to the propeller shaft. These engines are running continuously at full speed while the vessel is in operation. The power supplied by the electric generator is controlled directly from the bridge by a simple movement of a small control wheel. By this means the captain regulates the speed of the propeller and goes ahead and astern at will, without the assistance of any other individual aboard the vessel. The engineer in the engine-room sees that the engines and generators, as well as other equipment, are running properly, and the electric motor under the captain's control takes care of the rest. With this arrangement it was found that the propeller can be reversed from full speed ahead to full speed astern in 5 sec., and it all happens so smoothly that it may not be noticed by persons on board, not even the engineers unless they observe the direction in which the motor is turning. Special windings are provided on the generators, serving as a kind of shock-absorber, thus protecting the equipment from damage which would otherwise result from too quick starting, stopping, or reversing.

"While the motorship STANDARD SERVICE was primarily designed for work on San Francisco Bay, upon completion the vessel was immediately sent into Alaskan waters, and the flexibility of the equipment proved so satisfactory that an order was immediately placed for a duplicate vessel, and in December, 1923, our second Diesel-electric tanker, the ALASKA STANDARD, went into commission. This vessel was primarily constructed to meet the requirements of the Alaskan trade. However, the Diesel-electric features as installed on the STANDARD SERVICE were duplicated without exception. The two vessels were operating in Alaskan waters during the entire season of 1924, and have also operated there during the 1925 season, and all officers connected with the ship have expressed their extreme satisfaction with the operation of this type of propelling power. The ease with which these vessels can be handled from the bridge is particularly advantageous in the intricate passages of Alaskan waters. The fact that the navigating officer on the bridge directly controls the propeller movement is a decided advantage.

"The cargo-handling equipment of these vessels is also unique in that there are separate pipelines and pumps for each tank in the vessels, and it is thus possible to handle four or five grades of bulk oil at the same time without danger of mixing cargoes.

"Speed-regulating controls are fitted for the motors driving the cargo pumps, thus making it possible to discharge at any rate up to maximum.

"All auxiliary pumps throughout the vessel are motor driven, and the heating of the quarters is also done by electricity, as well as by hot water heated by the exhaust gases.

"Package freight is handled by electric-driven winches so arranged that one man operates two winches at the same time, thus giving the advantage of what is termed 'one-man control.'

"In the Alaskan service these vessels are virtually floating substations running between the various canneries and supplying them with any product which they desire, and their flexibility makes it possible for them to enter places where no other vessels of similar size have ever entered before.

"The success of these vessels was so complete that when request came for a vessel suitable for supplying substations in the Hawaiian Islands, a third Diesel-electric tanker, the HAWAIIAN STANDARD, was contracted for, and in March, 1925, this vessel went into operation. The service being quite different from that of the previous vessels, the general designs were altered, but the Diesel-electric type of propulsion, with its flexible features was duplicated.

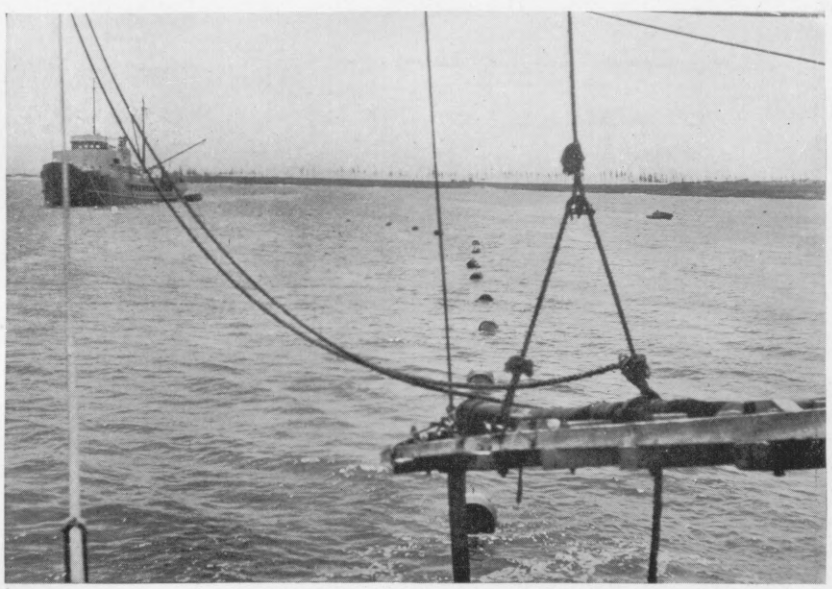
"Further advantage of this type of propulsive power was made use of in this vessel. For the purpose of operating in this particular service it was found desirable to place the engines amidships and the propulsion motor in the after end of the ship. To this, of course, there is no objection in Diesel-electric drive, as only electric cables connect the generators and the motor. These cables are carried from the generators in the engine-room up above deck and along deck to the after end of the ship and down to the propulsion motor aft. The engineer is in the engine-room tending the operation of the engines and generating equipment, making only inspection trips to the motor-room in the after end of the vessel at intervals to see that everything is as it should be.

"During the time the vessel has been operating in the inter-island service considerable favorable comment has been aroused among the various interests of the Hawaiian Islands. Before she was placed in commission our larger tankers delivered direct from the mainland to the substations at Hilo and Mahukona, on Hawaii, to Kahului, on Maui, and to Port Allen, on Kauai —and, of course, to Honolulu Main Station. All of those substations now receive their bulk stocks from the Honolulu Main Station, from which point they are transported by the HAWAIIAN STANDARD. Also the following new stations have been established in this field and are being constantly restocked in the same manner: Kailua, Paauilo, and Honuapo, on Hawaii; Lahaina, on Maui; Kaumalapau, on Lanai; Kaunakakai, on Molokai; and Ahukini, on Kauai. In making deliveries to several of our island substations it is necessary for the HAWAIIAN STANDARD to lie off-shore, from 100 to 800 feet, and pump her products to the stations through a hose suspended from pontoons.

"The principal industry of the Hawaiian Islands is cane-growing and the manufacture of sugar, with pineapples a close second. Most of the petroleum products delivered by the HAWAIIAN STANDARD are used in these industries—except at the Kailua substation, at which point the chief industry is coffee."

In the picture of the HAWAIIAN STANDARD discharging at the Port Allen substation of the company on the island of Kauai the barrels that are seen in the water are not containers but pontoons supporting the hose through which delivery of the oil is made. In the other illustration of her at the Kaumalapau substation on the island of Lanai, the shore derrick is shown unloading package cargo from the deck, while at the same time bulk oil is being pumped ashore through a hose.

A view of the deck cargo of the ALASKA STANDARD furnishes evidence that snow is no stranger in Alaska, notwithstanding the exhibits of home-grown potatoes, carrots, cabbages and strawberries offered by residents of South Eastern Alaska as proof of the mildness of the climate. Mining and canning are the two industries that create the major part of the demand for petroleum products in Alaska.



Hawaiian Standard discharging bulk cargo through a pontoon-floated hose

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Diesel-Electric Ferries for New York

A Fleet of Six Vehicular Ferries of Novel Type for Operation Across the Hudson River

NEW YORK is to have its first Diesel-engined ferryboats through the enterprise of the promoters of Electric Ferries Inc., a new company recently formed with railroad affiliations. Electric Ferries Inc. will operate six Diesel-electric boats between 23rd Street, New York City and the Erie Railroad terminal in New Jersey at Weehawken, almost directly across the river, and also between 23rd Street, New York City, and the terminal of the Erie Railroad at Undercliff, N. J.

Final details of the design of boat and machinery have not yet been settled. Considerable changes have been made since the designs were first sketched out and model tests made in the Washington tank. The boats will probably have a speed of 13 miles an hour and are likely to be about 155 ft. long and 48 ft. wide with a draft of 8½ ft. It was at first thought that 500 hp. would suffice for propulsion, but probably about 700 hp. will be installed.

Designed especially for automobile traffic, these ferry boats will have the unusual feature of a clear and unbroken parking space right over the main deck. Five lanes of autos will be carried, the center lane being designed for the accommodation of large trucks and passenger buses. The total accommodation will provide for about 40 automobiles and 5 buses. There will be no passenger cabins, the boats therefore being of a type different to those hitherto employed in large cities.

For terminals the new company has made a contract with the Erie Railroad, under the terms of which the railroad will lease to the ferry company for a period of 15 years the present ferry slips of the railroad at 23rd St., New York, and new slips with connecting roads and plazas at the two sites in New Jersey.

This proposal for a new line of ferries on the Hudson River, coming as it does at a time when the Hudson vehicle tunnels are about to be opened and when the first Hudson River bridge appears closer to realization than ever before, needs a few words of explanation.

Ferry accommodation on the Hudson River has not kept pace with the growth of the automobile traffic, and the resultant congestion at the ferry slips on both shores constitutes a big problem. On Sundays and holidays delays of as much as 5 hours are sometimes imposed upon motorists. Such delay cannot be counted as a commercial loss, no matter how great irritation it may cause. The delays in the truck traffic on ordinary days constitute, however, a considerable commercial loss.

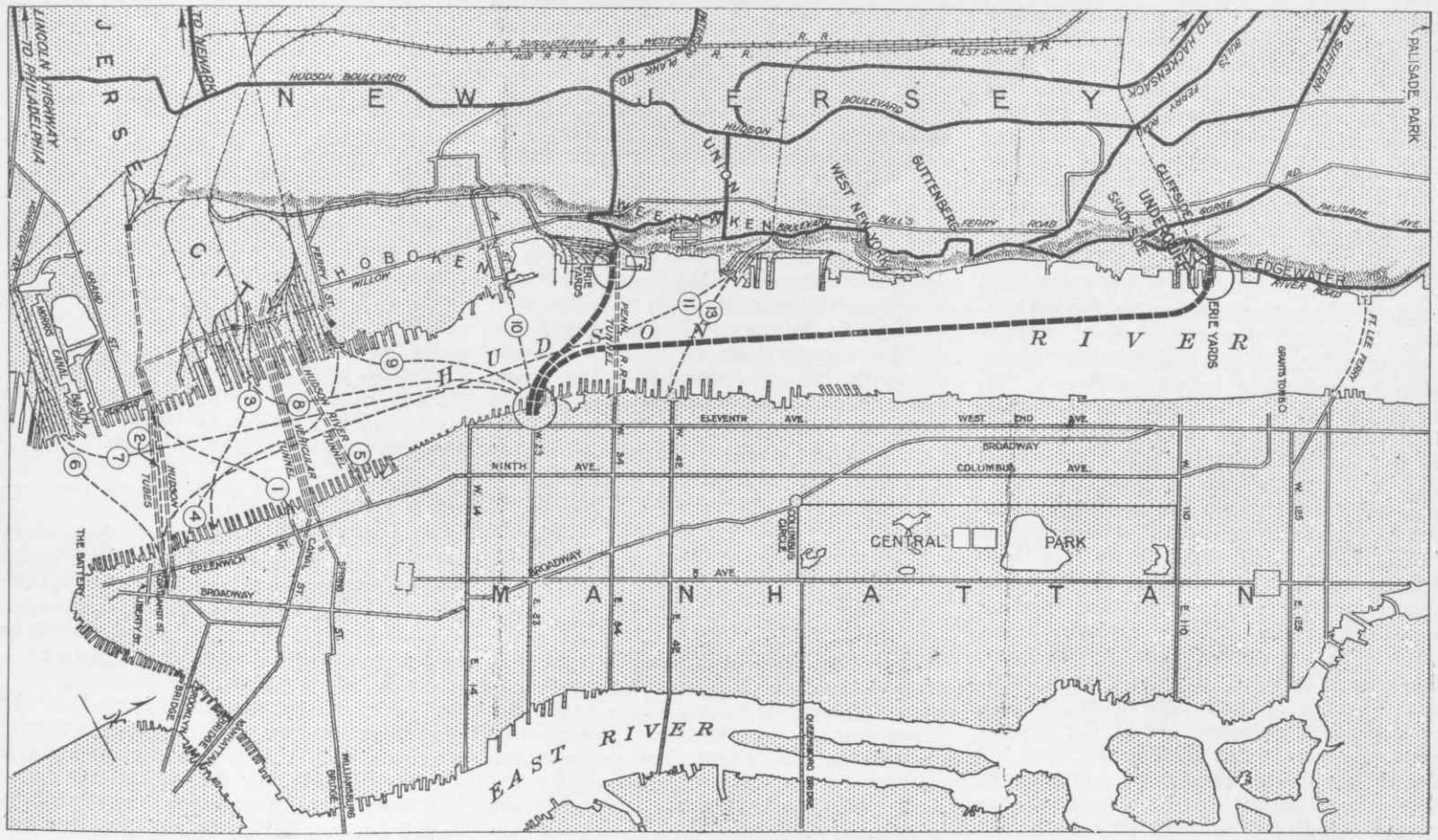
Truck traffic between New York City and New Jersey has increased enormously. The vehicular tubes under the river cannot take care of it all to advantage. The designed capacity of the tunnels is 46,000 vehicles daily, but the concentration of traffic which such a number of vehicles would represent, would create a congestion in the streets leading to the tunnels and block other traffic, which of course would not be permitted. There is no need to take into account at the present time the alleviation of traffic congestion by the proposed Hudson River bridge because construction work could not be commenced at least until next year and could not, therefore, be completed until 1932.

Statistics purport to show that more than 12,500,000 vehicles crossed the Hudson River in 1925. All were carried on ferryboats. This represents an average daily transportation of nearly 40,000 vehicles.

There can be no question that the Diesel-electric ferryboats operating between 23rd Street, New York and Undercliff, N. J. would take a large part of all the commercial and pleasure traffic passing between Manhattan and northern New Jersey. The ferryboat trip will occupy only about 20 min. between the slips, and the Hudson tunnels could not compete for that traffic.

On the short line between 23rd Street, New York and the Erie yards at Weehawken, there will be a lot of contract traffic. The Erie Railroad has, since 1922, unloaded its freight from railroad cars directly on to motor trucks, which have been ferried across the river, making direct delivery to the door of the consignee and picking up return loads. This railroad has particular classes of freight for which this system is especially suitable. It practically

(*Continued on page* 356)



Routes of the two projected Diesel-electric ferry services between New York City and two new ferry terminals in New Jersey

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Ashbee Continues Excellent Performance

Conclusions Drawn from 2 Years of Service, from Machinery Surveys and from Recent Change of Propeller

AFTER almost two years of operation in the West Coast trade of South America, the m.s. ASHBEE continues to give a very satisfactory account of herself. She is engined with the first Werkspoor Diesel turned out by the American Brown Boveri Electric Corp., formerly the New York Shipbuilding Corporation, a 1600 b.hp. 4-cycle 6-cylinder engine, having cylinders 27 in. diameter by 47 in. stroke. This engine was never run in the shop, most of the experiments having been conducted while the vessel was in steady operation, and since she is a mail ship her performance, of necessity, must be absolutely dependable.

The ASHBEE aroused a considerable amount of comment upon the completion of her first voyage, primarily due to two outstanding features of her performance. The first and most important of these was her demonstration of the practicability and economy of employing a comparatively large motorship in a trade which, theretofore, had been considered the undisputed domain of small steam vessels, enjoying the advantage of a considerably smaller capital outlay. The other demonstration, of perhaps less importance, since it applies to "steamship to motorship conversions" only, revealed an apparent economy in the retention of existing deck machinery, in so far as the saving in capital outlay was great enough to justify the admittedly wasteful process of burning fuel to generate steam.

Since leaving the plant of her engine builders she has never had to go back there for repairs and all surveys and steamboat inspection have been conducted without loss of time and without employing labor other than the regular engine room force. They have exposed for survey such items as pistons, crankpins and main journals, and in addition taken care of the regular routine repair work, during the time the vessel was discharging and loading cargo. The general condition of the engine, thus revealed, indicates that the time is not far distant when classification societies will ease up on the demands at present imposed upon motorships, and against which there exists a strong feeling among shipowners today. It so happens that this vessel is exceptionally well situated, as to available time in port, convenience of engine room arrangement and accessibility of engine design, and can on this account comply with the requirements of survey, without putting the owners to any extra expense.

An interesting sidelight upon the performance of this vessel is in connection with results obtained from her new propeller. The original blades were made of cast steel and intended for experiment only. However, while new, their performance proved so satisfactory that it was decided to use them until they deteriorated to a point of inefficiency where their retention could no longer be justified.

Some months prior to their abandonment in favor of bronze blades the inroads of erosion commenced to pit them so much as to effect the speed of the ship and a marked falling off in r.p.m. of the engine resulted, notwithstanding the fact that the i.hp. had been raised somewhat in a vain attempt to prevent this. During the life of the steel wheel the engines never turned up to its rated number of r.p.m. while the vessel was heavily laden. As a result the average m.i.p. had to be held at a point slightly above normal in order to have the engine deliver its full rated b.hp., a practice sometimes considered hazardous and which is in fact the case unless the engine is so designed that a high safety factor exists. That such a safety factor does exist is quite apparent, because the engine has suffered no ill effects as the result of being slightly overloaded for a long time.

In view of the existing conditions just described it was decided by the owners to reduce the pitch of the propeller from 10 ft. 6 in. to 10 ft., even though the new bronze wheel would be considerably sharper and smoother than the one of steel, and would naturally be an easier one to drive. In so doing it was expected that the engine would then be working at its best while the ship was deep in the water. The wisdom of this decision became apparent on the first voyage with the new wheel, for the r.p.m. jumped from approximately 102 to 110 while the m.i.p. went down slightly and the i.hp. remained about the same. This was while the vessel was heavily laden. While the ship was light about the only noticeable effect upon the engine was a decreased m.i.p. and b.hp. at the same r.p.m. The ship's speed remained about the same as that obtained while the cast steel wheel was new, notwithstanding the fact that the draft was greater and weather conditions were bad, making an exact comparison with earlier voyages impossible.

A contract for a sister ship to the m.s. UPWEY GRANGE, the 14½ knot refrigerated motorvessel put into service last year by the Houlder Line of London, has been let to the Fairfield Shipbuilding & Engineering Co. Like the UPWEY GRANGE the new vessel will have Fairfield-Sulzer engines.

Götaverken are preparing to handle larger vessels. Work was begun last year on a new fitting-out pier about 600 ft. long and it is expected that the construction will be completed this spring. Two outfitting cranes of 30 tons capacity each have been ordered and will have a sufficiently high lift to be able to take care of vessels of the same size as the GRIPSHOLM. In the event therefore, that the sister ship to the GRIPSHOLM be ordered from the Götaverken, as likely will be the case, the yard will be in a position to take care of the work.

Diesel-Electric Ferries for New York

(*Continued from page* 353)

controls the shipment of live poultry and of fresh California fruit coming into New York for local delivery. Plans have been drawn for the construction of a poultry abattoir in the Weehawken yards where poultry will be killed and dressed for the New York City trade, thus increasing the total poultry shipments into New York City via the Erie Railroad. These shipments alone are estimated to hold the promise of yielding an annual revenue equivalent to one-half the estimated total operating expenses of the six boats. The Erie has a special arrangement with the United States Trucking Corp., the largest trucking corporation in New York City, for direct pier and station delivery by truck.

In addition to this traffic the new ferryboat company expects to attract the interstate motorbus lines, of which there are already more than 20 regularly established. These buses are of the Pullman type, seating about 30 persons, and operate directly between residential sections of New Jersey and the shopping and theater districts of New York. Their number is growing so rapidly that every large community in northern New Jersey will undoubtedly soon be served by many buses of this type. The present ferry routes entail steep climbs or descents on the Jersey side and will benefit considerably by the new short line ferry, the Weehawken terminal of which is located at a break in the Palisades where steep grades are eliminated, causing the main arteries of travel to swing in close to the river. A short viaduct will be constructed across the Erie yards to conduct traffic to and from the pier directly to the main highways at only 5 per cent grade.

The interesting statement is made by the ferryboat company that because the ferries will make better time in the river between Undercliff and New York than the buses can make in traffic, the bus owners will be saved between 40 cents and 50 cents per mile operating expenses, or about $2.00 per trip on the 4½ mile haul from Undercliff to 23rd Street, New York. This is the feature that is expected to lead the bus owners to make contracts with the ferry boat company. It is estimated that about 1000 round bus trips a day originate in the territory to be served by the Undercliff Ferry Terminal.

Diesel engines of course have been selected for the propelling power because of their undeniable superiority. The electric system of propulsion has been adopted because the technical advisers of the company have considered that it offers advantages in maneuverability and in operating convenience. If only for the fact that the Diesel machinery permits the abolition of all the usual encumbrances in the center of the main deck it would have merited adoption for these vehicular ferries, but it has been estimated the Diesel-electric ferries will save $36,000 per year per boat as compared with steam ferryboats of the same capacity and that is what counts most.

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Aorangi Makes Good Record First Year

Motorliner on Canadian-Australasian Run has Covered a Distance Equal to Four Times Round the World

FROM the time she left the River Clyde on Dec. 30, 1924, AORANGI has shown a record of increasing efficiency on a particularly trying run. She has been in continuous operation, first on her maiden voyage from Southampton to Vancouver, B. C., via the Panama Canal, and then on the Canadian-Australasian run between Vancouver, B. C., and Sydney, N. S. W.; by way of Honolulu, Suva, and Wellington, N. Z. It is a long run of 7,638 nautical miles each way between Canada and Australia, and little time is wasted in port, yet Henry Lockhart, Chief Engineer, reports the engines working with increasing efficiency and economy.

Up to the beginning of this year AORANGI had covered 101,788 miles at an average of 16.54 knots. The time which this motorship spends at sea is considerably greater in proportion than that of passenger liners on the Atlantic run between New York and Southampton. AORANGI'S schedule calls for a round trip of 15,276 nautical miles every eight weeks, of which 43 days are spent at sea and 13 days in port, though the vessel sometimes gains additional time in port due to arrival from 6 to 12 hours ahead of schedule. On account of getting ahead of time she sometimes has to slow down on approaching port in order not to arrive before the shore people are ready.

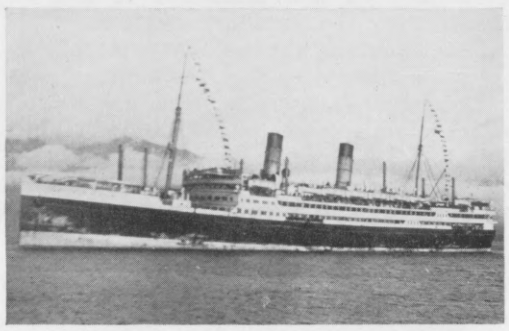
A stay in port of 5 days is made both at Vancouver and at Sydney, and the schedule shows a stop of 6 to 8 hours at Honolulu and Suva and about 24 hours at Auckland, though the times at the intermediate ports vary considerably with the amount of cargo to be handled.

The engineers are limited in their time for overhauling by having to shift ship with the main engines at the various ports, so that there are not five clear days at either end of the voyage, the shift usually coming about the middle of the stay. Even the shorter calls are broken by shifting to different wharves.

AORANGI, with a displacement of 23,000 tons, and measuring 600 ft. by 72 ft., is driven by quadruple propellers, with four 6-cylinder Fairfield-Sulzer engines developing a total of 13,000 s.hp. at 127 r.p.m. Her fuel consumption at sea ranges between the low average of 53 tons a day for a voyage to as high as 56 tons a day. About 9 tons a day are used for the galley and for raising steam in one boiler, steam being used for the refrigerating machinery, heating and laundry. The balance is used by the main and auxiliary Diesel engines. There are four 410 hp. Diesel auxiliary sets, and these supply power to the turbo blowers which provide scavenging air for the main engines, as well as power for steering, lighting and other purposes.

In port the fuel consumption averages 8 tons a day, 7 tons being used in firing the boiler supplying steam for winches, and about 1 ton by the Diesel electric generating set.

While the fuel consumption does not vary much, the Chief Engineer reports a very marked saving of lubricating oil since the first voyage. On the maiden voyage the AORANGI'S average daily consumption of lubricating oil for all purposes was 300 imperial gal., but on her last 1925 trip this had been reduced to only 125 gal. a day, namely, 45 gal. for cylinder lubrication and



Aorangi finishing a voyage at Vancouver

80 gal. for other purposes. D. T. E. extra heavy is being used in the crankcase and 600 W. for the cylinders. The centrifuge for purifying oil in the lubricating system is run for two hours each watch. Mr. Lockhart says that with the reductions in the consumption of lubricating oil during the past year, he has been enabled to build up a reserve equal to the total quantity of oil in the lubricating system.

The following table of voyages shows the average speed maintained and the average engine revolutions, 130 r.p.m. representing full power:

Aorangi's Record of Passages

PASSAGE	BETWEEN	SPEED	ENGINE
Maiden voyage	Southampton to Vancouver	16.24 knots	112.5 r.p.m.
No. 1 South	Vancouver to Sydney	16.37 "	116 "
No. 1 North	Sydney to Vancouver	16.3 "	114.7 "
No. 2 South	Vancouver to Sydney	16.25 "	113.3 "
No. 2 North	Sydney to Vancouver	16.44 "	116.2 "
No. 3 South	Vancouver to Sydney	16.58 "	116 "
No. 3 North	Sydney to Vancouver	16.68 "	114.4 "
No. 4 South	Vancouver to Sydney	16.79 "	117.4 "
No. 4 North	Sydney to Vancouver	16.88 "	117.9 "
No. 5 South	Vancouver to Sydney	16.32 "	115.2 "
No. 6 North	(voyage numbers changed)	16.96 "	118.1 "
No. 6 South	Vancouver to Sydney	16.1 "	117.5 "
No. 7 North	Sydney to Vancouver	17.1 "	117.9 "

On No. 1 passage South from Vancouver heavy gales and very high seas were experienced during the early part of the voyage, the ship being at one time hove to for 18 hours. Other voyages were also affected by bad weather, the slowest trip No. 6 South being due to this cause, only 16.1 knots being averaged at an engine speed of 117.5 r.p.m., while on the next voyage North 17.1 knots were made at an engine speed of 117.9 r.p.m.

The voyage number after the 5th passage South from Vancouver has been changed to the 6th passage North from Sydney, the voyages now being reckoned from Sydney.

It will be noted that the average engine revolutions are well below 130 r.p.m. at which the engines develop their full power, so that there is a good margin of power in reserve to make the designed speed of 18 knots, or even better if required.

Actually the highest number of revolutions per minute recorded is 118.1 on voyage number 6 north, the average speed on this voyage being 16.96 knots. The vessel always runs well to schedule time, so it will be seen that unless the scheduled time for voyages is shortened, AORANGI is not likely to have to use her full power consistently. This seems a wise policy because it always ensures a reserve of power for emergency purposes.

AORANGI is said by her officers to steer splendidly, and the automatic course record bears this out. With engines stopped in smooth water the tendency of the ship's head is to blow off, no doubt on account of the drag of the propellers, but when running with a heavy wind abeam she has a tendency to head up into the wind on account of there being more of the superstructure aft.

The triple screw steamer NIAGARA, a somewhat smaller ship of 20,000 tons displacement, 544 ft. long by 66 ft. breadth, runs opposite the AORANGI on the same run, maintaining the same time schedule. On a recent trip between Honolulu and Vancouver she averaged about 17 knots, and is said to burn about 110 tons of fuel oil a day under her boilers to drive the two reciprocating engines and a central turbine, besides auxiliaries. She thus requires more than twice the fuel though 56 ft. shorter and 6 ft. less in breadth than the AORANGI and having passenger accommodation for 800 persons compared with 1,000 which the AORANGI can carry. The latter's passenger accommodation is considerably more in proportion, on account of space economies made possible by her Diesel engines.

Four motorliners of 12,000 tons each for the Lloyd Nacional Brasileiro, of Rio de Janeiro, have been ordered in Italy. The hulls are to be built by the Cantiere Navale Triestino and the machinery will be of the Fiat type.

Fitting-out of the Cosulich liner SATURNIA has been delayed because the builders are rushing construction on all hulls in the yard in order to launch them before June 30, when the present Italian shipbuilding subsidies expire. Vessels launched after June 30 will not be entitled to the subsidy.

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West Vancouver Ferry is Economical

Boat for 280 Passengers Operated at 10 Knots at Cost of 68 Cents an Hour for Fuel and Oil

WEST VANCOUVER'S new passenger ferry operating between the city of Vancouver and Ambleside landing in the municipality of West Vancouver, B. C., was put in commission last year and soon began to demonstrate the economy of oil engine operation.

This ferry run presents a number of unusual problems. The route is through First Narrows, the harbor entrance, where heavy traffic in a passage less than ¼ mile wide, combined with tides exceeding 8 knots at times, make navigation difficult in the fogs that occur at some seasons. The strong tides make a fairly fast boat necessary, because the harbor traffic regulations require outbound boats to keep to the north side of mid-channel where they have to face the full strength of the current for over a mile when the tide is flooding. The ebb tide when it meets a westerly wind or swell in English Bay forms tide rips, the steep and angry crests of which are held in much respect by mail craft.

A ferry boat makes the round trip of about 8 miles every hour from 6 o'clock in the morning till midnight, while an additional boat is put on to carry the extra traffic between 7 a. m. and 9 a. m. and between 5 p. m. and 7 p. m. The boats on this run maintain the service with remarkable regularity, rarely missing a trip, no matter what the conditions of wind and weather, while trips cancelled through engine trouble have been rarer still. The service for the past 10 or 12 years has been maintained by boats of 80 hp. and 110 hp. with heavy duty distillate engines and with a passenger capacity of 130 to 150 in summer.

The new Diesel engined ferry named WEST VANCOUVER No. 6 was built by S. R. Wallace at North Vancouver from designs by T. Halliday, and is equipped with a 6-cylinder 200 hp. Atlas-Imperial engine developing its power at 300 r.p.m. She measures 107 ft. o.a., 99.6 ft. between perpendiculars, 18 ft. beam, 8 ft. molded depth and 6 ft. draft. The hull is built principally of fir, over 1¼ in. by 3¼ in. bent oak frames, spaced 12 in. apart. The engine seating consists of floors 8¾ in. sided and longitudinals 9¾ in. sided, extended as far as possible fore and aft. The engine is installed amidships and is directly reversible. A fresh water circulation system is installed for cylinder cooling. Fuel is carried in two 600 gal. tanks placed on each side at the after end of the engine room. There is also a 75 gal. tank for lubricating oil and tanks for 70 gal. of gasoline for the auxiliary engines.

The layout of the auxiliary machinery has been planned so that the engineer has it all under observation from his station at the main engine control. It is all installed on a flat on the starboard side. Opposite the main engine controls at the after end of the engine room is a 4-cylinder Universal gasoline engine direct connected to a 110-volt 4 kw. generator. Immediately above it is the switchboard, protected with wire gauze. Next forward is another 9-12 hp. Universal engine direct connected to a rotary pump for bilge and fire purposes; then a Sharples centrifuge for the lubricating oil; and at the forward end the auxiliary Atlas combination gas engine and compressor. On the port side of the engine room are a workbench and the boiler of the steam heating system.

The boat is equipped with Johnson-Fries pneumatic steering gear, a lever in the pilot house controlling the air valve to two pistons right aft which work directly on the rudder. There is also the ordinary handwheel. Under ordinary operating conditions the compressor on the main engine pumps sufficient air for maneuvering, for air steering and for the whistle without the need of using the auxiliary compressor.

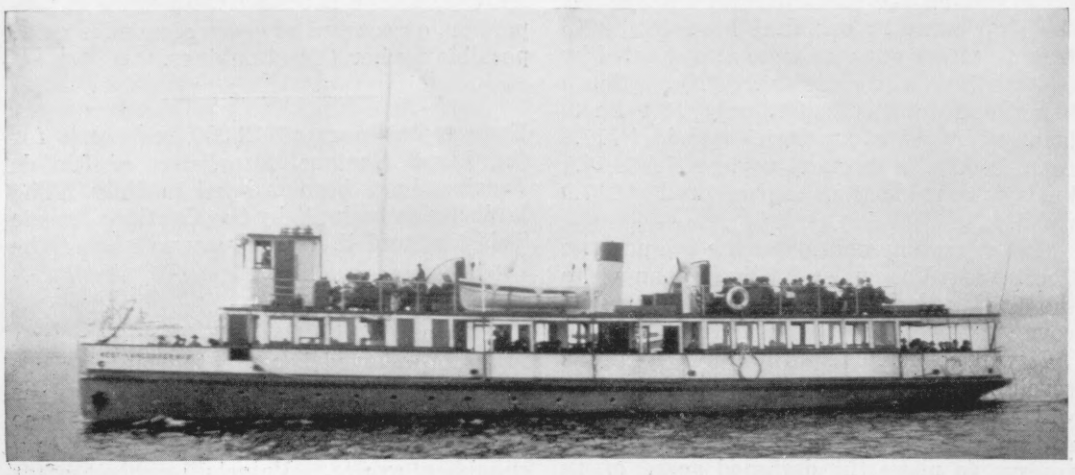
A 16-hour test under ordinary operating conditions of the ferry run, with the boat making 10 knots, showed a fuel consumption of 100 imperial gal. and 2 gal. of lubricating oil, the price of Diesel oil being 8 cents per gal. and lubricating oil $1.10 per gal. The electric light engine, which is the only auxiliary that affects the consumption of gasoline to any appreciable extent, burns about ¾ gal. per hr. at full load, gasoline costing 20 cents per gal. So that with the light engine in operation on an average 6 hours out of the 18 hours between 6 a. m. and midnight, the average operating cost of main engines and auxiliaries has been figured by the engineer at 68 cents per hour.

Of the older boats on this run, SONRISA, 80 ft. o.a. by 15½ ft. beam, with 80 hp. Atlas distillate engine driving her about 9 knots, costs $1.05 per hour for engine operation—her fuel consumption being 5½ gal. of distillate at 18 cents per gal., while lubricating oil runs 24 hours to the gallon. She has a passenger license for 130 in summer and somewhat less in wintertime. After covering more than half a million miles on this ferry run since 1913, SONRISA is a little heavier on fuel than when she was new.

Ferryboat West Vancouver No. 6

WEST VANCOUVER No. 5, 90 ft. o.a. by 16½ ft. beam, with 110 hp. Atlas distillate engine costs $1.70 an hour for engine operation, using 8½ gal. of distillate, while lubricating oil runs her 12 hours to the gallon. She has a passenger license for 150 in summer.

From the foregoing it will be seen that the Diesel engined WEST VANCOUVER No. 6 costs for engine operation only 25 per cent of the combined cost of operation of the two other boats, the total passenger carrying capacity of which is 280, while their combined horsepower is 190, or practically the same as the capacity and power of the new boat. The two older boats are each operated by a crew consisting of captain, mate and engineer; while the new boat has one extra man on deck.



This ferry has displayed unfailing regularity and great economy under severe conditions

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A small steel tanker is being built for the Imperial Oil Co. by Wallace Shipyards, Ltd., at North Vancouver, B. C. This vessel measures 92 ft. b.p., 19 ft. beam, and will be equipped with a Diesel engine of about 250 b.hp. expected to give her a speed of 9 knots. She has 6 cargo tanks of 100 tons d.w. capacity, carries 2,000 gal. of fuel, and will have two cargo pumps of about 50 g.p.m. capacity. She will be used on the British Columbia coast.

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Developing Traffic on the Mississippi

Reports of the Inland Waterways Corporation Show That Freight Line Can Be Profitably Operated

THAT two Diesel-electric tunnel stern towboats of 1500 hp. each will probably be ordered by the Inland Waterways Corporation furnishes an indication of the progress that is being made toward the use of modern equipment for inland water borne commerce.

On the lower Missisippi the Inland Waterways Corporation has been very successful, and is rapidly approaching the point at which the service can be sold to a private operator.

Every week there is one sailing of a barge tow and one sailing of a self-propelled barge from each terminal, i. e., New Orleans and St. Louis. The Corporation has six towboats, which are oil-burning steamers, superior to any others of their type ever put on American waterways, but considerably inferior to the Diesel electric towboats which the Corporation has designed and desires to build.

A tow of the Inland Waterways Corporation on the Mississippi River

Four of the towboats operate with three barges upstream. Each barge loads to about 2000 tons on its designed draft, but in periods of low water this loading sometimes has to be reduced. These tows operate on a schedule which averages 265 hr. from New Orleans to St. Louis and 108 hr. southbound.

Two towboats are reserved for the handling of tows of bulk cargoes, which are not operated on such a fast schedule as the regular tow. These tows consist of not less than five barges and sometimes as high as seven or eight barges if cargo is offered. The bulk cargoes are chiefly grain, bauxite and sugar, and their respective tonnages during the fiscal years ending June 30th, 1924 and 1925, were as follow:

Bulk Cargoes in Long Tons

COMMODITY	1924	1925
Grain	220,652 tons	261,227 tons
Bauxite	143,762 tons	174,966 tons
Sugar	121,878 tons	156,897 tons

Grain is downstream and the other two commodities move upstream.

During the calendar year 1924 a total of 850,000 tons was carried by the Mississippi line of the Inland Waterways Corporation, which operates the year round. General cargo is carried as well as bulk cargo.

The weekly service of self-propelled barges from New Orleans and St. Louis are operated on a faster running schedule than the tows. The self-propelled barge averages 9 or 10 miles an hour through the water. Northbound she is scheduled to make the run in 211 hours, followed by a lay time of 101 hours at St. Louis before she begins the southbound trip, which is scheduled for 100 hours, followed by a lay time of 92 hours at New Orleans. This is equal to a round trip in 21 days. Rates are lower than those of the railroads, and a very considerable saving is being made by the shippers who use the large lines.

These figures relating to the Government owned line are the only ones available about the Mississippi traffic. It is understood, however, that the Goltra Line is carrying at least an equal tonage. If it be remembered that prior to the war there were no such barge lines in existence it will be understood that a development is taking place which would very probably never have started except for the initiation of this river service by the Government during the war period. Opinion on the river holds that the traffic is capable of considerable expansion, and that the day will come when the great Mississippi River will carry an enormous traffic, not only between cities on its own banks, but also between those cities and others on the big rivers which empty into it.

It is encouraging to note that Brigadier General T. Q. Ashburn, Chairman and Executive of the Inland Waterways Corporation, was able to show in his last statement of operations that the Mississippi service was showing a profit sufficient to take care of depreciation of all the equipment and to return a dividend on the Corporation's investment.

A line is also operated by the Corporation on the Warrior River between Mobile and Birmingport, which is the water terminal of Birmingham, Ala. Connected with this line is the Mississippi Sound service between Mobile and New Orleans. The traffic between Birmingport and New Orleans is handled by what is termed the Warrior Division of the Corporation. This division is not yet meeting expenses, but the loss has been very greatly reduced, and there is a reasonable prospect for believing that the Warrior System will soon be on a paying basis. Each week a towboat and barge are dispatched from each end of the Warrior River Line. Their chief freight consists of manganese ore and sulphur upstream and coal and steel products down. On the Mississippi Sound self-propelled barges make a round trip per week.

The Osaka Shosen Kaisha has ordered two motorships of 1,500 tons gross to be propelled by twin sets of 600 hp. Vickers engines. The vessels will be built by the Mitsubishi Zosen Kaisha at Kobe.

OAKBANK, 5200 tons gross, another motorvessel for the Bank Line, has been delivered by Harland & Wolff. She measures 434 ft. by 53 ft. 9 in. by 37 ft. and is propelled by two Harland-B. & W. motors similar to those in the other vessels of the same character built for the Bank Line.

ATHELKING, a twin screw molasses tanker for the British Molasses Co. Ltd., has been built by Swan, Hunter & Wigham Richardson Ltd. She is 475 ft. long with 11 cargo tanks, at the bottom of which steam pipes are installed to heat the molasses until it is sufficiently liquid to be handled by the pumps. She is propelled by two Neptune 6-cylinder engines.

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A NEWS item tending to illustrate the increase of motorships under the American flag appeared in many newspapers last month. It announced the arrival of the motorship WILLIAM PENN at Honolulu with the motorship MAZATLAN in tow. The WILLIAM PENN had gone to her assistance after receipt of radio messages from the MAZATLAN relating that she was disabled several hundred miles off Guam in a little frequented part of the Pacific.

For the Marine Transit Co. of New York four motortugs are now building for service on the New York State Barge Canal. Two of them will have engines of 240 hp. and the other two will have engines of 180 hp., all of the Fairbanks, Morse type.

A new radio beacon on the French coast at Ushant will assist vessels provided with radio direction finders on approach to th English Channel from the South. It sounds a musical note on a 1000 meter continuous wave.

All the vessels of the American Hawaiian S. S. Co. are to be equipped with radio direction finders. The flagship CALIFORNIAN and her sister the MISSOURIAN, the two big motorvessels of this line, were provided with Kolster radio compasses some time ago and two of the company's steamers were similarly equipped. As a result of the trial the American Hawaiian S. S. Co. has now ordered 17 Kolster sets for the remaining vessels of the fleet.

The U. S. Battleship TENNESSEE is just fitting the first commercial type radio direction finder adopted by the Navy. Hitherto all navy vessels have used exclusively the navy type radio direction finder. The type purchased for the TENNESSEE is the Kolster.

GULFCREST, the big new motortanker of the Gulf Refining Co. has been equipped with an R.C.A. radio direction finder.

Bids on Two Conversions

For the installation of two McIntosh & Seymour 6-cylinder single-acting 4-cycle engines of 2700 s.hp. each in the WEST HONAKER and WEST CUSSETA, now in the James River, and for the work incidental to the conversion of the vessels from steam to Diesel power, five bids were received by the Shipping Board, as follow—

List of Shipyard Bids

NAME OF BIDDER	ONE SHIP	TWO SHIPS
American Brown Boveri Elec. Corp.	.....	$930,500
Bethlehem S. B. Corp.	.....	815,000
Federal S. B. & D. D. Co.	.....	950,000
Morse D. D. & R. Co.	.....	1,016,000
Todd Shipyards Corp.	$468,767	.....

For completion of the contracts the Todd Shipyards Corp., bidding for its Tietjen & Lang yard, specified 120 days. The Bethlehem Shipbuilding Corp. promised 120 days and 135 days for the first and second ships respectively; Morse Dry Dock, 130 days and 140 days; American Brown Boveri Electric Corp., 140 days and 155 days; and Federal Shipbuilding Corp., 160 days and 185 days. These bids formed the third of the series of installation bids.

Motorship

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Readers are invited by the Editor to submit articles, photographs or drawings relating to motorships, marine oil-engines or auxiliaries. Contributions used in the magazine are paid for on the 15th of the title month of issue, and other contributions are returned as promptly as possible.

GULFCREST, the 13,000 tons d.w. oil tanker constructed by the American Brown Boveri Electric Corp., Camden, N. J., for the Gulf Refining Co. ran preliminary trials early in April and is expected to be handed over to her owners early in May. She is run between Port Arthur, Tex., and New York.

A number of large fish packing companies as well as independent fishermen are ordering new fishing craft of the seine boat type this spring, as well as fish-carrying cannery tenders. The seine boats average between 50 and 65 ft. length with 12 to 14 ft. beam. With very few exceptions they are being equipped with 4-cycle airless injection Diesel engines or 2-cycle oil engines of surface-ignition types, the powers used ranging from 50 to 75 b.hp. Two 85 ft. fish carriers are having 125 hp. 4-cycle Diesel engines. Orders for building more than a dozen of these fishing craft were given during January and February to Vancouver shipyards alone.

A combined passenger and freight boat having a capacity for 150 passengers and 4 carloads of freight, is being built by the Prince Rupert Drydock Co. at Prince Rupert, B. C., and will operate between Penticton and Kelowna on Okanagan Lake, B. C., in connection with the Canadian National Railway. She will be purely a day boat, having sleeping accommodation only for the crew. She will be built of steel and knocked down for reassembly at Kelowna. Her measurements are 127 ft. o.a. by 22 ft. beam, and she will be equipped with twin 6-cylinder direct reversing surface-ignition oil engines of 440 hp. total. A speed of about 15 miles an hour is expected.

A log raft towboat, the NORWOOD, owned by R. E. Chesley of Seattle, has been converted from steam to Diesel power. She measures 102 ft. overall, 17 ft. beam and draws 17½ ft. of water. Her new engine is a 200 hp. Standard, turning a 3-bladed propeller of 67 in. diameter and 35 in. pitch. When the boat is running light the propeller turns about 400 r.p.m., giving a speed of about 10¼ knots. On a test with the tug tied up alongside a pier the propeller turned about 310 r.p.m. The boat can tow rafts of between 1,500,000 and 2,000,000 board feet of logs.

Gripsholm's Radio Compass

A letter from Mr. Lundmark, chief officer of the Swedish American motorliner GRIPSHOLM, giving an account of the value of radiobeacons and radiobearings appeared in a recent issue of the Lighthouse Service Bulletin. Mr. Lundmark's letter is given in full below.

"On the GRIPSHOLM is installed a radiocompass, made in London. During the time this has been in use it has proved to be a very great aid to navigation. Especially is this the case on this side of the Atlantic, where radiobeacons are much more numerous than on the other. The various beacons operated by your department constitute the greatest help to ships fitted with direction finders. Not only in foggy weather, because, as you no doubt are aware, it happens frequently we have to run for days without any observations, and when we near Nantucket we start taking our bearings as far as 150 miles out. So far they have proved as correct as any sight bearing.

"This time on approaching New York we made a test on Ambrose, a distance of 400 miles, and the error turned out to be less than 1 deg. Also on last westward passage while out in the Atlantic we were in communication with the DROTTNINGHOLM by radio and expected to sight her when a heavy snow set in. Continuous radiobearings were taken showing her at first only about 3 deg. on starboard bow. For safety, course was altered and as vessels approached each other bearings started to change rapidly. I was working the compass myself, and, when I reported her abeam a temporary lift in the fog showed the DROTTNINGHOLM exactly as indicated by the direction finder.

"On our eastbound passage when making the Orkneys, where soundings have little value and there are no radiobeacons or direction finding stations available, we took a cross bearing on Bergenradio and Wickradio, respectively 300 and 100 miles away. The position later proved correct within 4 miles. We have dozens of similar instances and consider our direction finder most essential to navigation.

"Through the experience we have obtained, the commander, myself, and the other officers of the GRIPSHOLM are strongly in favor of a system of radiobeacons and bearings taken from the ship. Undoubtedly when ship officers get more acquainted with the direction finder the general opinion will force the radiobeacon to the front as an aid to navigation. Our radiocompass is placed in the chart house and is operated solely by the deck officers.

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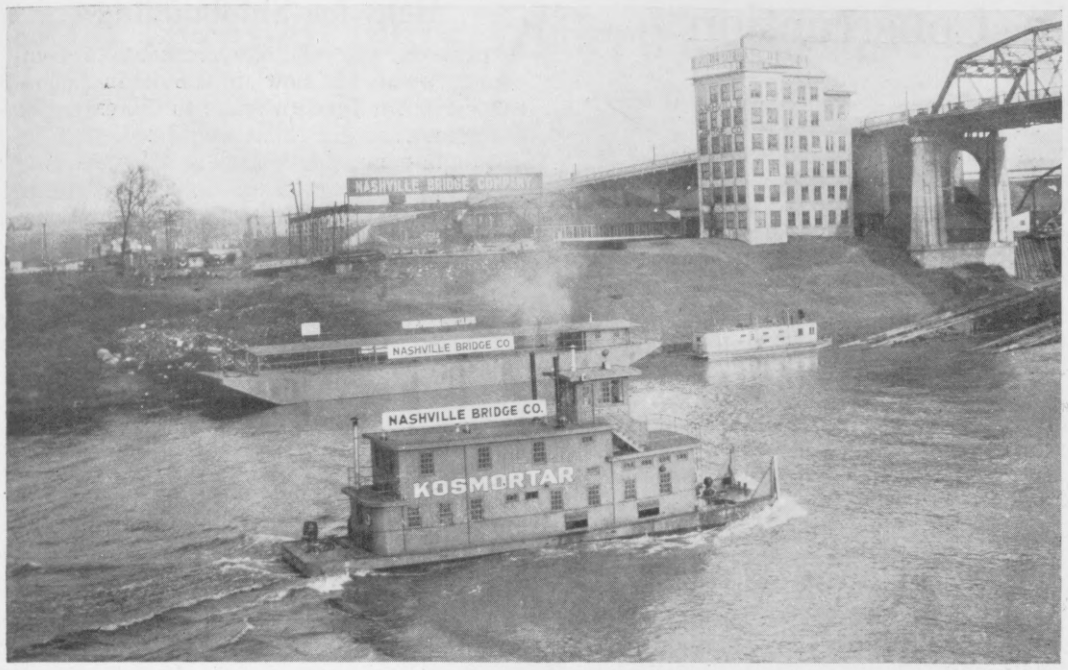


Twin-screw motortug of the Kosmos Portland Cement Co. for service on the Ohio River

The ninth annual meeting of the American Coast Shipbuilders' Corporation will be held in Philadelphia on May 10, when shipbuilders from all sections of the United States will discuss means for strengthening the American shipbuilding industry by encouraging domestic ship construction.

PHOENIX, one of the latest additions to the fleet of towboats in New York harbor, recently made her maiden trip from Rockland, Me., where she was built, to New York, taking first a tow to Boston, then a tow through the Cape Cod Canal and finally a light tow to New York. She belongs to Capt. Henry Rohde and is 60 ft. 6 in. long, 17 ft. 5 in. beam with a draft of 6 ft. 6 in., measuring 54 tons gross. For power she has a 200 hp. Standard airless injection engine, with six cylinders 10 in. bore and 14 in. stroke swinging a 64 in. x 42 in. 4-bladed steel propeller at 300 r.p.m.

Cruise of Asturias

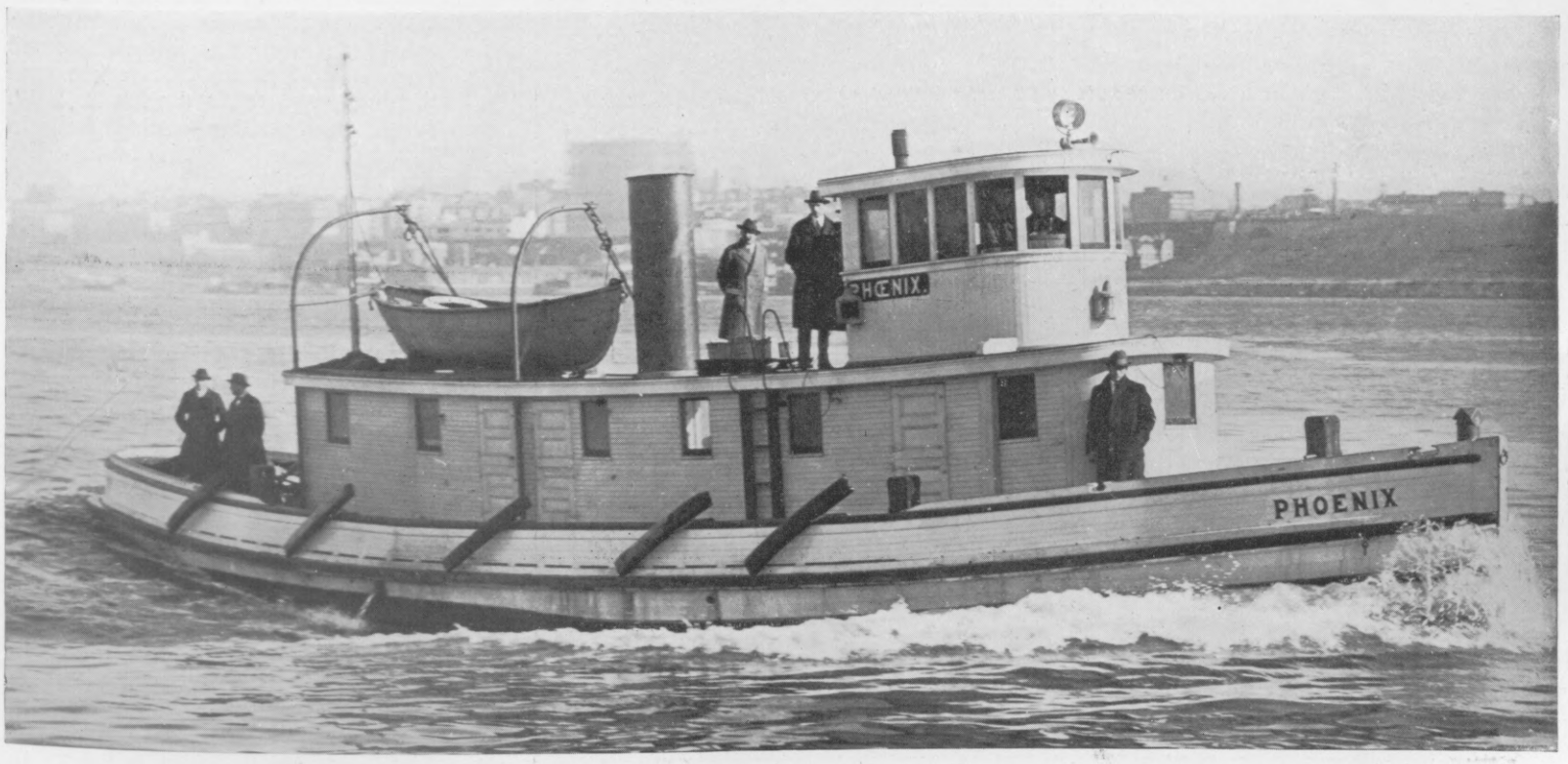
Ideally suited as motorships are for the long passenger cruises now becoming so popular, the appearance of the big motorliners on the Atlantic gave assurance that motorship cruises would soon be advertised. By reason of its superior comfort and cleanliness, the motorliner is a more attractive vessel for tourists, and after the appearance of the GRIPSHOLM in American waters the conclusion became obvious that the tourist agents would not be tardy in recognizing the possibilities of the motorship. Advertisements now announce the sailing of the R. M. S. P. motorliner ASTURIAS for a winter cruise to Africa starting from New York in January next. She is the biggest motorliner in service, a vessel of 22,500 tons gross and of 20,000 i.hp., built by Harland & Wolff and now running between South America and England.

Ohio River Tug

For its barge traffic on the Ohio River the Kosmos Portland Cement Co. of Louisville, Ky., ordered last summer two Diesel-engined towboats. The first of these, named the KOSMORTAR, has been delivered by the Nashville Bridge Co. of Nashville, Tenn. The new towboat is 75 ft. long, with a beam of 19 ft. and draws 4½ ft. of water. She is a twin screw boat with a 2-cycle airless-injection Worthington engine of 120 hp. on each shaft, swinging a 48 in. manganese bronze propeller. Both stern tube bearings are of the Goodrich Cutless rubber type, which are lubricated by water and not affected by sand or grit. One of the special features of the boat is the use of copper bearing steel for the plating in order to minimize corrosion in waters contaminated by strong discharges from industrial plants. This is the second oil-engined boat owned by the Kosmos Portland Cement Co., the first having been the KOSMOS, completed in 1922.

P. R. R. No. 18, a Diesel-electric towboat for the Pennsylvania Railroad, was completed last month. She is very similar to P. R. R. No. 16.

Both contracts made by the General Steamship Co. of San Francisco with Norwegian owners for the supply of tonnage cover new motorships. Winge & Co. of Oslo, who are at present keeping the motorships TOSCA, INDRA and GEISHA, together with the steamer POLJANA on the berth, will add a new motorship now building of 7900 tons d.w. for June-July loading, and the m.s. VINLAND, of 7500 tons d.w. for August-September loading, with possibly another motorship later. The new line from North Pacific ports via the Magellan Straits to the east coast of South America will be maintained by the motorships BRANDANGER and HOJANGER, both of 8300 tons dw. and by three steamers, all owned by Westfal, Larsen & Co. of Bergen.



A recent addition to the rapidly growing fleet of motortugs in New York: Phoenix, a new boat built in Maine, 54 tons gross, 200 hp.

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World's Motorship Construction

SHIPBUILDING returns for the quarter ending March 31, 1925, issued by Lloyds Register, indicate that motorships under construction in world shipyards at the present time aggregate 913,099 tons, while steamers and sailing ships total some 1,097,000 tons. The motorship tonnage represents 83 per cent of the steam tonnage or just 45 per cent of the total tonnage of all types under construction in the world.

This position is indicative of good progress when it is reflected that it has been wholly attained in the comparatively short space of 13 years and mostly within the last four years, as shown very pointedly in the table below, which gives the steam and motor figures at March 31 each year from 1922.

World Construction 1922-1926

DATE	MOTOR TONS GROSS	STEAM TONS GROSS	MOTOR STEAM PER CENT
March 31, 1922	293,000	3,357,000	8.6
March 31, 1923	327,000	2,511,000	13
March 31, 1924	694,000	1,801,000	38.5
March 31, 1925	1,022,000	1,358,000	75
March 31, 1926	913,099	1,097,000	83

As compared with the figures at Dec. 31 last year, there is a slight decrease in the number of motorships under construction in the world—913,099 tons gross as against 1,007,381 tons at Dec. 31, 1925.

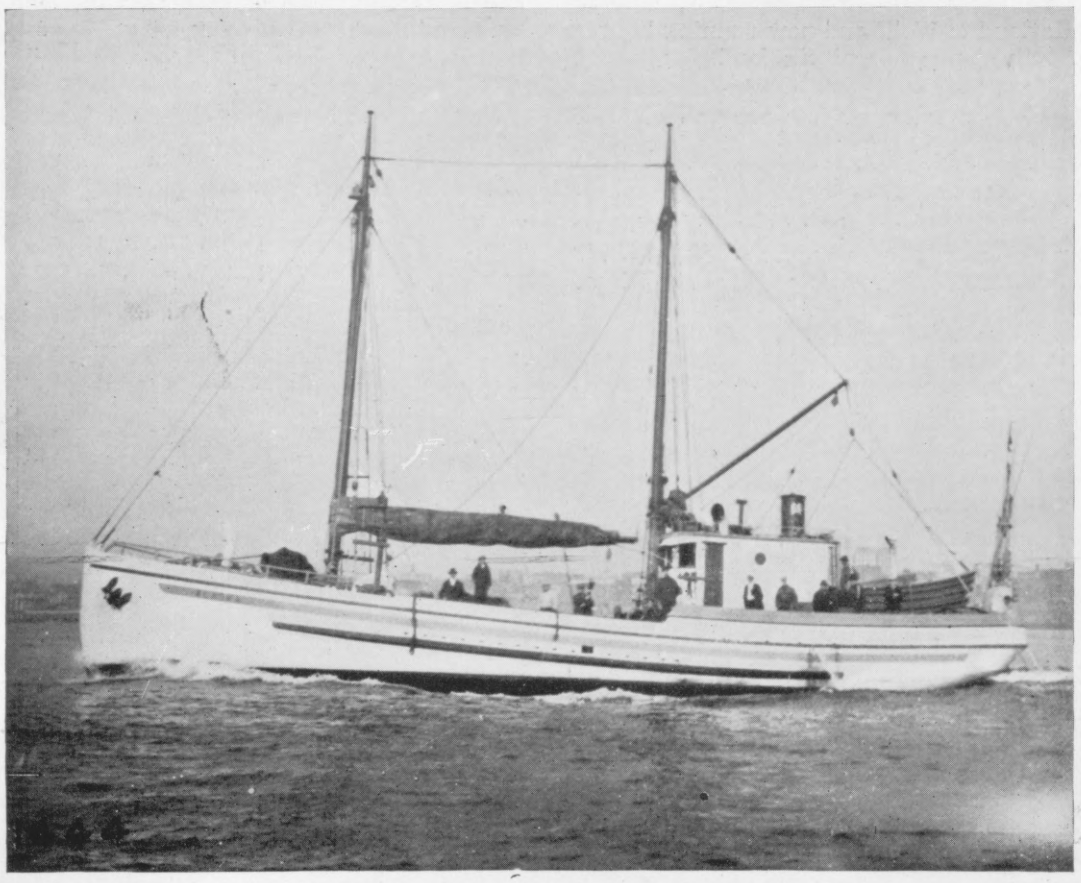
The outstanding country in motorship construction during the past 18 months has been Italy, and the present returns show that the number of motorships building there is still on the increase. On March 31, 1925, Italian shipyards had under construction vessels totalling about 84,000 tons to be equipped with internal combustion engines. This had increased on Mar. 31 of this year to nearly 221,000 tons gross.

In British shipyards there are some 9800 tons less of motorshipping under construction now than at the end of the previous quarter, but this may be regarded as generally indicative of the bad times through which British yards are passing.

The returns show that the power of oil engines under construction in the world totals 733,496 i.hp. as compared with 432,968 i.hp. for steam reciprocating engines and 362,415 i.hp. for steam turbines. For countries other than Great Britain oil engines under construction comprise 55 per cent of the total machinery building, with reciprocating engines at 20 per cent and turbines at 25 per cent.

Five of the President type vessels maintaining the Shipping Board service between the Pacific Coast and Oriental ports have been sold to the Dollar interests for $4,500,000.

GULF OF VENEZUELA, 6661 tons gross, a motor tanker operated by the Gulf Refining Co. in coastwise service, was the third victim of a series of disasters that occurred in quick succession to tankships in Gulf waters last month. While she lay at the dock in Port Arthur, Tex., after loading 55,000 bbl. of high test gasoline, an explosion took place aboard the GULF OF VENEZUELA. The calamity happened at night, and a number of men were killed in their berths. What caused the explosion has not been determined. The GULF OF VENEZUELA was bought by the Gulf Refining Co. from the Shipping Board last year, and her conversion from steam to Diesel power was effected at the Sun yard in Chester in a period of less than 6 months. She is a single screw boat with an engine of 2500 hp.



Halibut schooner Alaska which holds the record between Seattle and Ketchikan, Alaska

Help for Shipbuilding

A proposal for the Government to compensate owners of new ships built in American yards for foreign trade to the extent of the amount of duty that would be collectible upon the component parts of the vessels if they were imported in fabricated form, has been introduced into Congress by Senator George Wharton Pepper of Pennsylvania and was referred to the Senate Committee on Commerce last month. It was inspired by the American Coast Shipbuilders' Association.

Gripsholm Sailings

Travelers to Northern Europe can enjoy the luxury of the motorliner, with its superior internal arrangements, more comfortable cabins, spotless cleanliness, noiselessness and lack of vibration, by sailing on the twin-screw motorliner GRIPSHOLM, 17,300 tons gross, which has the following scheduled sailings this summer between North American ports and Gothenburg, Sweden:

Schedule of m.s. Gripsholm

FROM NEW YORK	FROM GOTHENBURG
April 29†	May 18
June 3	June 19
July 3*	July 28*
August 11	August 28*
September 11	September 25

†Calling at Boston, Mass., on April 30.
*Tourist 3rd cabin carried on this passage.

Minimum rates to Gothenburg are: 1st class $195; 2nd cabin $152.50; 3rd cabin $108 eastbound and $119.50 westbound, with $10 extra for tourist 3rd cabin one way or $15 extra on the round trip. GRIPSHOLM is more like a yacht than any vessel in the transatlantic service.

A Sister to Gripsholm

A loan of 8,000,000 kr. ($2,144,000) has been voted by the Swedish Parliament to assist the Swedish American Line in building another motorliner like the GRIPSHOLM. The new vessel, which it is now assured will be constructed at the Götaverken yard in Gothenburg and engined with B. & W. type 4-cycle double-acting engines built in the Götaverken shops, will be launched in November, 1927, and take her place in the summer sailing schedule of 1928. Preliminary announcements in MOTORSHIP have detailed the progress of the negotiations leading to the Swedish Government loan just authorized.

Record Halibut Schooner

Captain C. O. Angell's halibut schooner ALASKA holds the record for any fishing vessel between Seattle and Ketchikan, Alaska, a distance of 651 miles. Captain Angell's boat has made the run in 65 hours. He claims she can do better than 11 knots when forced, equal to more than 12½ miles per hour. Built in 1913 in Seattle by the Nelsen & Kelley Shipbuilding Co., she first had a 110 hp. gasoline engine installed. This was replaced in Jan., 1925 by a 135 hp. Washington-Estep engine operating at 280 r.p.m. and turning a 60 in. by 51 in. wheel. ALASKA measures 82 ft. by 18 ft. by 9 ft. She fishes mostly in Alaska waters.

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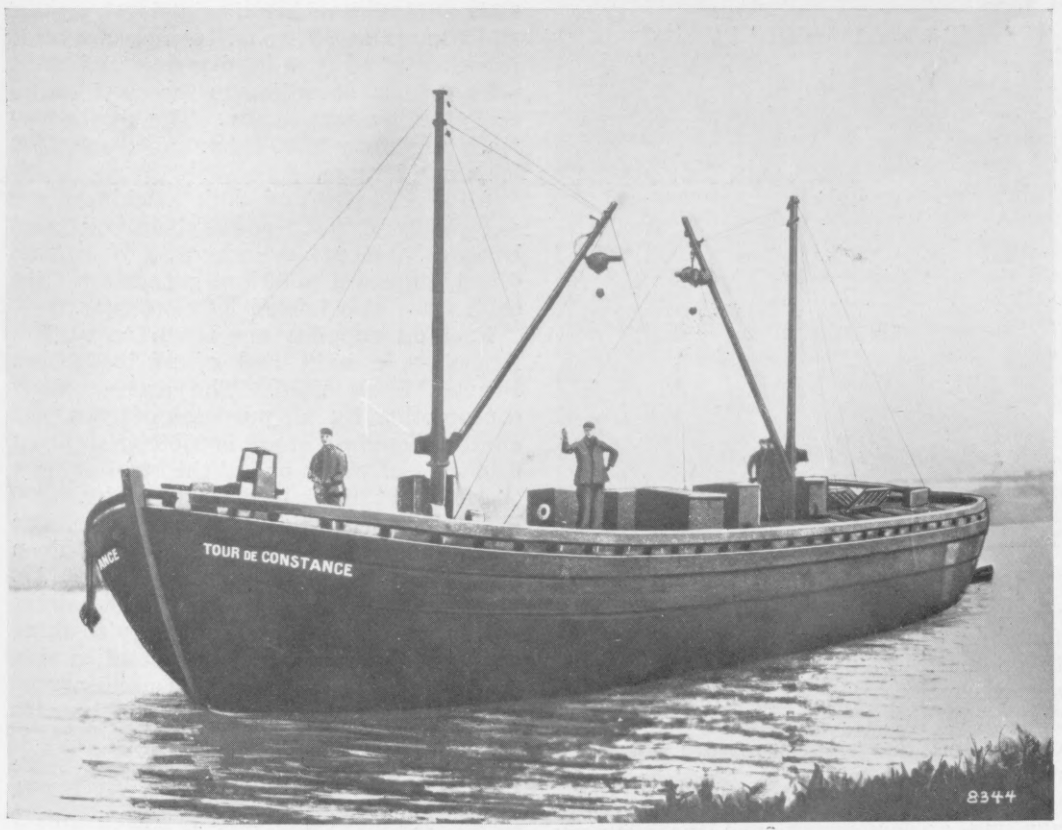
French Diesel-Electric Barges

OPERATING between Paris and Bordeaux on the Midi Canal are seven canal boats of 100 tons d.w.c. which have the distinction of possessing the smallest Diesel electric propulsion outfits to be found anywhere in the world. The main engine is a 2-cylinder 14 hp. Diesel motor direct connected to a 100 volt d.c. generator with a special exciter mounted on an extension of the armature shaft. The electric power is conveyed from the generating plant to two electric motors turning at 1800 r.p.m., driving through reduction gear to the twin propeller shafts which operate at 180 r.p.m.

These boats of course, operate only in still water and the owners are quite content with a speed of three miles per hour. One of the chief advantages of this type of propulsion is that it permits full pilot house control. The speed of the engine and generator is constant, and the motors are controlled by variation of the field current. The pilot has these hand controllers on deck, and with them alters the speed or reverses as desired.

Use is also made of the electric power for loading or discharging. The boats are equipped with two cargo derricks operated by electric winches with a capacity of 1500 lb. at a hoisting speed of 250 ft. per min. The boats are lighted by electricity, and a powerful searchlight is installed in the bow to facilitate navigation at night. One of these boats, the TOUR DE CONSTANCE is illustrated on this page.

A larger type of canal boat using similar equipment, but with engines of either 22 hp. or 30 hp., is also used on the French Canals. These boats have a cargo capacity of 270 tons and a speed of about 5 miles per hour loaded. The development of the Diesel electric system on the French Canal boats is very largely due to the Hill Diesel Engine Co. of Lansing, Michigan, which has supplied all the engines.



French canal barge with Diesel electric power for propulsion and cargo handling

Annie Johnson

When the new Johnson Line motorship ANNIE JOHNSON on her maiden voyage from Europe called at the principal Pacific Coast ports from the Panama Canal to Vancouver, B. C., her chief engineer reported having made an average of 12¼ knots on the outward passage with the engines turning 116 to 117 r.p.m. At 12½ knots, the ordinary sea speed, her fuel consumption is 11½ tons a day for all purposes, of which a 150 hp. Diesel generator set taking care of the electric auxiliaries and steering gear at sea uses 0.6 ton. The lubricating oil consumption is stated to be 35 gal. a day of new oil, of which 20 gal. is used for cylinders and 15 gal. for bearings, 10 gal. of the latter being reclaimed by a centrifuge. In port the fuel consumption, with two of the three auxiliary Diesels running to supply power for the winches, etc., is reported to be about ¾ ton a day.

With a length of 409 ft. o.a. and breadth of 52 ft. 6 in. the ANNIE JOHNSON has a draft of 24 ft. 9¾ in. when loaded to about 7,300 tons d.w. capacity. She was built at Gothenburg, Sweden, by Götaverken and is powered with twin 6-cylinder long-stroke Götaverken-B. & W. engines of 3,500 i.hp. aggregate at 120 r.p.m. There is about 1200 tons of refrigerator space with two CO_2 machines, each driven by a 40 hp. electric motor. The electric steering gear has a 20 hp. motor, and there are 25 hp. electric winches and a 100 hp. electric windlass.

The Path of a Pioneer

"The East Asiatic Company has now sold its last steam-driven vessel—the s.s. BANKA, built in 1919, 1684 gross tons—and its fleet today consists exclusively of Diesel motorships, for one can also include in this class the beautiful 5-masted barque KOBENHAVN, which also has a Diesel motor as auxiliary.

"At a time when the number of motorships building is in excess of steamships building, it is well to cast one's mind back to that proud day in the shipping history of Denmark when the first ocean-going motorship in the world—the SELANDIA—left the famous yard of Burmeister & Wain. This was a 'red letter day' indeed, but it was more than that. It marked the initial step of a great venture and the crowning act of a man who had already achieved success such as few men achieve.

"Denmark's 'grand old man,' H. N. Andersen, the founder and guiding spirit of the East Asiatic Company, recognized the possibilities of the new method of propulsion and backed his belief with every penny of his vast wealth. Events have proved his foresight to have been true in this.

"Not so long ago Danish university students were asked to say who in their opinion was the most prominent man in Denmark today. With an almost overwhelming majority they gave that honor to H. N. Andersen. There was nothing remarkable in this. While changing Governments have ever made Denmark smaller, he created a greater Denmark. His was no conquest of territory in the military sense; but wherever his boundless enterprise took root in foreign countries, Danish repute and Danish influence grew, and fresh and sorely needed values were brought to Denmark. To those who understand figures, what a story lies behind the brief announcement in his company's latest annual report: 'Throughout the year the company has brought into Denmark foreign currency to an amount of 166 million kroner, and in Danish banks redeemed credits and acceptances to an amount of about 138 million kroner!'

"It would be a difficult matter to place the East Asiatic Company under one definite category, for its business comprises almost everything: shipping, trading, agriculture, manufacturing. In its report on the shipping business, the company says that this gave a net profit of 5,846,234 kroner, 'presumably due to the economic working of the motorships in the company's service.' Behind this natural and modest sentence must lie boundless pride. For has not the miserable year of 1925 made it obvious to all that the road to follow is that travelled by the motorship? There is no salvation elsewhere, and now, in 1926, the shipyards which have orders will tell of that excess of motorship tonnage now building. The position is the same in practically every country. The development of the motorship as the future ocean carrier is now in full swing, and it was started by one man—H. N. Andersen. Had it not been for his enterprise in 1912, there is no doubt that the motorship would not have been so far advanced as it is today, for the war with its clogging influence came shortly afterwards."—*Scandinavian Shipping Gazette.*

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Lillehorn in B. C. Trade

LILLEHORN, previously the MAJONG, is an oil-engined steel freighter of about 1500 tons deadweight capacity, brought out from Great Britain early in 1926 and chartered to B. L. Johnson, Walton & Co., of Vancouver, B. C., for general freighting service on the British Columbia coast. This is the third small steel oil-engined freighter from Great Britain to be put in the British Columbia coastwise service during the last year or so, besides a number of local freighters that have been equipped with oil engines.

This ship has the machinery and crew's quarters aft, and the main hold has a hatch opening almost the full length of the main deck, cargo being worked by derricks on two pole masts.

She measures 214 ft. o.a., 207 ft. 6 in. b.p. and 33 ft. 6 in. breadth, with a deadweight capacity of about 1500 tons including fuel bunkers on a mean loaded draft of 14 ft. 4 in. Her fuel oil capacity of 310 tons is largely in double bottom tanks, while the fore peak has a capacity of 62 tons and the after peak 56 tons.

She was built in 1922 in England, but not completed till some years later. She has two 4-cylinder Bolinder oil engines of 16½ in. cylinder bore and 18 15-16 in. stroke developing 350 hp. at 225 r.p.m. These engines, originally built for air injection and rated 320 hp. each at 225 r.p.m., were first used in another ship. Then new heads with an airless fuel injection system were put on. These are stated to have been installed and guaranteed by Bolinder's London branch, and the engine rating increased to 350 hp. at 225 r.p.m. The high compression air compressor having thereby been dispensed with, the only compressor installed in the LILLEHORN is a single-stage single-cylinder compressor for pumping up pressure in the starting air bottles, this compressor being connected by a clutch with a 15 hp. horizontal oil engine used also for running a 9 kw. generator.

W. MacKay, the chief engineer who brought her out to the Pacific Coast, states that the daily consumption of fuel at sea on the trip averaged about 2¾ tons, and 26 gal. of new lubricating oil was the daily average. About 10 gal. of lubricating oil out of this was reclaimed by the De Laval centrifugal oil separator and used again in the auxiliaries.

The principal auxiliary engine is a 2-cylinder Fairbanks Morse vertical oil engine developing 75 b.hp. at 300 r.p.m. and direct connected to a 50 kw. generator. It is installed aft between the propeller shafts and supplies power to four 25 hp. cargo winches, a warping winch and anchor windlass, pumps and lights, the little vessel being equipped with electric auxiliaries throughout. For use at sea there is a 15 hp. single cylinder horizontal Fairbanks Morse oil engine driving a 9 kw. generator, which has sufficient capacity to take care of the electro-hydraulic steering gear, fuel transfer and ballast pumps and electric lighting. This little engine also drives the compressor when required.

The main engines are fitted with electric plugs for starting, a 7 to 12 volt current at 300 amp. being supplied by a 3.6 kw. generator driven by a 6¼ hp. electric motor. There are also the usual torches for standby purposes.

LILLEHORN sailed from Leith and called at Antwerp for cargo, then made a stop at the Azores, passed through the Panama Canal and finally reached Vancouver after a running time of 61 days. There were some delays. On one occasion a wristpin seized and burst the piston, which had to be replaced by a spare one while the LILLEHORN proceeded under one engine. A more serious delay was occasioned by the 50 kw. generator going out of business. Her officers report that some time was spent at the Azores trying to get this repaired, but the shore facilities for doing the work were found to be poor and they finally decided to go on to Balboa where they had the armature rewound. A rather interesting feature of this boat is that water can be carried in the after peak for use in the circulation system of the auxiliary engine if the ship is loading at ports where she is aground at low water, and the ordinary sea cocks cannot be used.

Lillehorn in British Columbia waters

A motor passenger liner of about 9200 tons gross, named the ACCRA, has been launched for Elder Dempster & Co., who have the distinction of being the pioneers of the motor passenger liner. The Elder Dempster Co's motorship ABA, the first motor passenger liner in the world, was put into service in 1918 and has since been running in the Company's West African service. The new vessel which measures 468 ft. 9 in. by 62 ft. by 35 ft. is intended for the same service and will be propelled by two Harland-B. & W. 6-cylinder 4-cycle double-acting engines of a normal rating of 3750 hp. each. These engines will drive their own compressors instead of having separately driven compressors, as was the case with the ASTURIAS' engines.

Akagisan Maru

AKAGISAN MARU is one of the first of the Japanese motorship fleet to engage in trans-pacific trade.

K. Kume, who has been with the ship since her first voyage, as first assistant engineer and now as chief engineer, reports she is working out very well and there has been no accident of any kind to the machinery. Up to the present he has not had an opportunity to try out the speed and fuel consumption under deep loaded conditions, but on a late trip from Vancouver, B. C., the ship had a heavy cargo. With light to moderate loads the AKAGISAN MARU has been making the run from Yokohama to San Francisco or Seattle in 16 to 18 days, depending on load and weather conditions (often bad), the average speeds ranging from 10 to 11¼ knots.

AKAGISAN MARU is 375 ft. long, 50 ft. beam, 24.4 ft. loaded draft and a deadweight cargo capacity of 6980 tons. Built at Mitsui & Co.'s own shipyard at Tama on the Inland Sea of Japan, she is equipped with a 6-cylinder long-stroke engine built by Burmeister & Wain at Copenhagen. This engine gave her a trial trip speed of 12.18 knots at 93 r.p.m. turning a 4-blade propeller of 15 ft. 9 in. diameter and 12 ft. pitch, which, according to the chief engineer, gives a negative slip. The engine normally develops 2300 i.hp. or about 1800 b.hp. at 87 r.p.m.

All auxiliaries and deck machinery are electrically driven, power being supplied by three 70 b.hp. 2-cylinder B. & W. engines direct connected to 50 kw. generators. The cabins are also heated by electricity.

Fuel oil supplies are taken on at San Francisco, a light fuel of 27 to 28 deg. Beaumé being used. The average daily consumption for all purposes of main and auxiliary engines at sea is 6556 kg. or about 6.44 tons, of which one of the auxiliary sets operating at light load uses 168 kg. (370 lb.). In port, when working cargo, two of the auxiliary engines are operated on an average fuel consumption of 210 kg. (462 lb.) a day. When working all hatches at once it is sometimes necessary to bring the third generator set into operation also, but this has only been found necessary on one occasion since the ship has been in operation.

A Vacuum lubricating oil is being used; the daily consumption being 1½ gal. D.T.E. heavy X for compressors and auxiliary engines, 7 gal. of D.T.E. Extra Heavy for cylinder lubrication and 2½ gal. of D.T.E. heavy medium for bearings. Up to the present none of the fouled cylinder oil has been reclaimed, but a centrifugal separator is to be installed shortly, when the ship is up for her annual survey.

Since the ship has been in commission, the chief engineer states the inlet valves have had a very light grinding on two occasions, and the exhaust valves receive attention on an average every two months, some of them being removed each month.

AKAGISAN MARU is being operated on the run between Japan, North China and the Pacific Coast ports of the United States and Canada, together with a fleet of steamers which the Mitsui Co. of Tokio also operates on this trade route. This company is said to be building a smaller motorship for the China run, to be equipped with a B. & W. engine of trunk piston type.

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Small Canadian Coaster Gains by Conversion

Increases Capacity 25 Per Cent, Doubles Cruising Radius and Gets More Speed With Oil Engine

CONVERSION of the s.s. COASTER by the installation of a four-cylinder Fairbanks, Morse engine developing 100 b.hp. at 340 r.p.m. has proved very satisfactory according to H. Rendell, manager of the Coast Steamship Co., of Vancouver, B. C. Besides this vessel the Coast S.S. Co. operates three steam freighters out of Vancouver to British Columbia ports and Puget Sound.

The COASTER was built in 1916 and measures 94 ft. b.p., 21 ft. beam, 7 ft. 2 in. molded depth, with a loaded draft of 7 ft. forward and 9 ft. aft. She has a flat bottomed type of hull, of wood construction, built to operate in shallow harbors and rivers and in partly protected coast waters, there being an outer chain of islands most of the way along the British Columbia coast and up to Alaska.

The machinery, crews' quarters and pilot house are aft. Her former power was a compound steam engine, with cylinders 8 in. and 16 in. by 12 in., using 140 lb. steam pressure, turning at 150 r.p.m. and estimated to deevlop about 60 s.hp. The bunker capacity was 22 tons of coal—besides which extra coal was often carried—and the fuel consumption averaged 2½ tons a day for the trip. Her cruising radius was about 1000 miles, or the round trip from Vancouver to the Nass River and return, with extra coal on deck. This coal cost $7.50 for nut and $8 for lump per long ton at the coal mining port of Nanaimo at the time of her conversion.

With the new 100 b.hp. Fairbanks, Morse oil engine, a 52 in. by 34 in. 3-blade propeller is turned at 340 r.p.m., and an average increase of speed of ¾ knot is obtained with the extra power. The fuel capacity is now 2000 imperial gal., which at an average consumption of 2 gal. per mile gives her double the previous cruising radius and is sufficient for a good month's operation, or two round trips from Vancouver to Naas River. The fuel used by the 22 hp. single cylinder stationary type oil engine to drive the double drum winch is almost negligible, the 30 gal. fuel tank only requiring to be refilled every two weeks.

At the time of her conversion last summer oil fuel cost 7.5 cents an imperial gallon at Vancouver and 3.45 cents an American gallon at Seattle. On the basis of the previously mentioned cost of coal at Nanaimo and the cost of fuel at Vancouver, Mr. Rendell says that the cost of fuel and lubricating oil for operating the boat is only 35 per cent of what it previously was per steaming mile, though the power has been increased from approximately 60 to 100 b.hp. and the vessel's speed increased as a result.

Further, the oil fuel does not vary like coal, states Mr. Rendell, but can be depended on for a definite amount of power. He has found bunker coal to vary greatly. On one occasion his steamer MATSQUI took on 32 tons of bunker coal for a round trip to the Skeena River from Vancouver, but her fuel ran so low on the northward trip that she had to go into Prince Rupert for more coal before proceeding to make her calls up the Skeena. At Prince Rupert 10 tons of bunker coal were taken on, with which she made her Skeena calls, returned to Vancouver and then went over to Nanaimo, the southward trip taking about a third of the coal that was burned northbound. While this is no doubt an exceptional case it goes to show how steam coal can vary.

Besides the increase in speed, which was mainly a matter of increased power, the cruising radius was doubled with only about a quarter of the weight of fuel previously required for the shorter distance. Three days a month have been saved through not having to go to Nanaimo for bunker coal, and a day and a half saved through not having to blow down boilers. The coaster now loses practically no time, as she can fill her fuel tanks in about an hour once a month, without making any special trip for it, apart from the short move in port.

As a steamer she carried 135 tons d.w. normally as a full load, with a maximum load of 150 tons on short trips. Now, with the increased cargo capacity which the oil engine equipment permits, she carries 170 tons normally and has carried as much as 187½ tons on a short trip, and this with full fuel tanks, as she trims better with a heavy load when the fuel tanks are full.

The usual cargoes which the COASTER carries are cases of canned salmon, salt salmon and herring southbound, and box shooks, empty cans and general cargo northbound. Lime and other cargoes are also carried as occasion demands.

The primary reason for converting the COASTER was a cracked boiler which necessitated getting a new one or an engine that did not need a boiler.

Small Coaster's Long Passage

ARRAN FIRTH arrived at Vancouver, B. C., from Scotland last fall under command of Capt. G. Mollison and with C. A. Hook as chief engineer. She had been bought by the Frank Waterhouse Co. of Vancouver, B. C., operators of coasting freighters in British Columbia waters. Her previous owner was G. T. Gillie, of Glasgow, Scotland, who operated a fleet of small coasting steam freighters, the ARRAN FIRTH being the only motorship of the fleet.

She came out in ballast, half loaded trim, and had a good voyage, except for bending the crankshaft, which caused a delay of 9 weeks at the port of Las Palmas while repairs were being made.

ARRAN FIRTH is a steel vessel of the single hold type with machinery aft. She was built in 1921. Her length is 138 ft. 3 in., breadth 23 ft. 3 in., molded depth 10 ft. 6 in., depth of hold 9 ft. 9 in. and 346 tons gross. Her one hold has a cargo capacity of 20,230 cu. ft. and her ordinary deadweight cargo capacity is about 320 tons on a loaded draft of 10 ft. 4 in. The one cargo hatch measures 15 ft. by 47 ft. 3 in.

She is driven by a 4-cylinder Bolinder engine, developing 320 b.hp. at 325 r.p.m., which gives her speed of about 10 knots with a light load. These engines have a cylinder bore of about 16½ in. and about 18⅞ in. stroke. She carries 21 tons of fuel in six cylindrical tanks, which gives her a cruising radius of 14 days at 9½ knots. A 2-cylinder 50 b.hp. auxiliary oil engine is direct connected to a generator which supplies current for electric deck winches and windlass. There is also a small 2½ hp. electric lighting set.

ARRAN FIRTH left Cowes, Isle of Wight, after taking six additional tons of gas oil in drums in the hold. This fuel cost 8 pence 3 farthings (about 17 cents) an imperial gallon. Three days after leaving Cowes the cause of engine trouble was located in a bent crankshaft, and ARRAN FIRTH ran the balance of the way to Las Palmas, a distance of 900 miles, on three cylinders, it being necessary to take out No. 2 piston which was nearest to the bend in the crankshaft. No. 2, being one of the two reversing cylinders, left only one cylinder to reverse on, but in spite of this handicap it was still possible to maneuver with the engine, and the speed was only reduced to 8¼ knots. The little motorship was delayed at Las Palmas while the bent crankshaft was removed, turned up true again and replaced. The engineer who had started out as chief left her at Las Palmas, and Mr. Hook took his place, bringing her the rest of the way.

Las Palmas was left on August 8 and Vancouver reached on October 10. The average speed maintained was 8½ knots. Rough weather was experienced on the Atlantic, and for reasons of fuel economy on the long run the engines were not opened up to full speed. On the run up the Pacific Coast, however, between San Pedro and Vancouver, Mr. Hook says that she was run at full speed, making an average of 10 knots at 223 r.p.m. with head wind and sea. The average consumption on the trip was 1½ long tons of fuel a day and 12 gal. of lubricating oil, a Vacuum D.T.E. heavy oil being used. The fuel taken on the trip out was gas oil for the first stages, and gas oil was also loaded at Trinidad; but Diesel oil was taken at the other ports of call. After leaving Las Palmas the ARRAN FIRTH made a stop of 18 hours at Trinidad, 4 hours at Colon, 6 hours at Panama and 6 hours at San Pedro.

ARRAN FIRTH is the second small steel motorship to be brought out from Great Britain within a year to go into the British Columbia coasting trade, while oil engines have been installed in several other vessels engaged in general freighting in coast waters during the same period, and two are described on these pages.

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Ocean Type German Motortug of 2350 hp.

Satisfaction with 900 hp. Motor Tug Leads Hamburg Firm to Order Tug of More Than Double Power

ON account of the economical and satisfactory operation of the motortug HERMES which it has had in service since 1922, the Bugsier-Reederei und Bergungs A-G., of Hamburg, ordered in 1924 the big ocean tug WOTAN of 2400 hp. The HERMES is a boat of 300 tons gross, with registered dimensions 131.2 ft. x 22.6 ft. x 13.4 ft. with two A.E.G. engines of 900 s.hp. total. The WOTAN is a bigger and much more powerful boat with Krupp engines, and was completed at the Krupp yards early in the summer of 1925.

Designed for a speed of 15 knots in service, the WOTAN showed on her contract trials a speed slightly exceeding 16 knots. Her chief dimensions are—

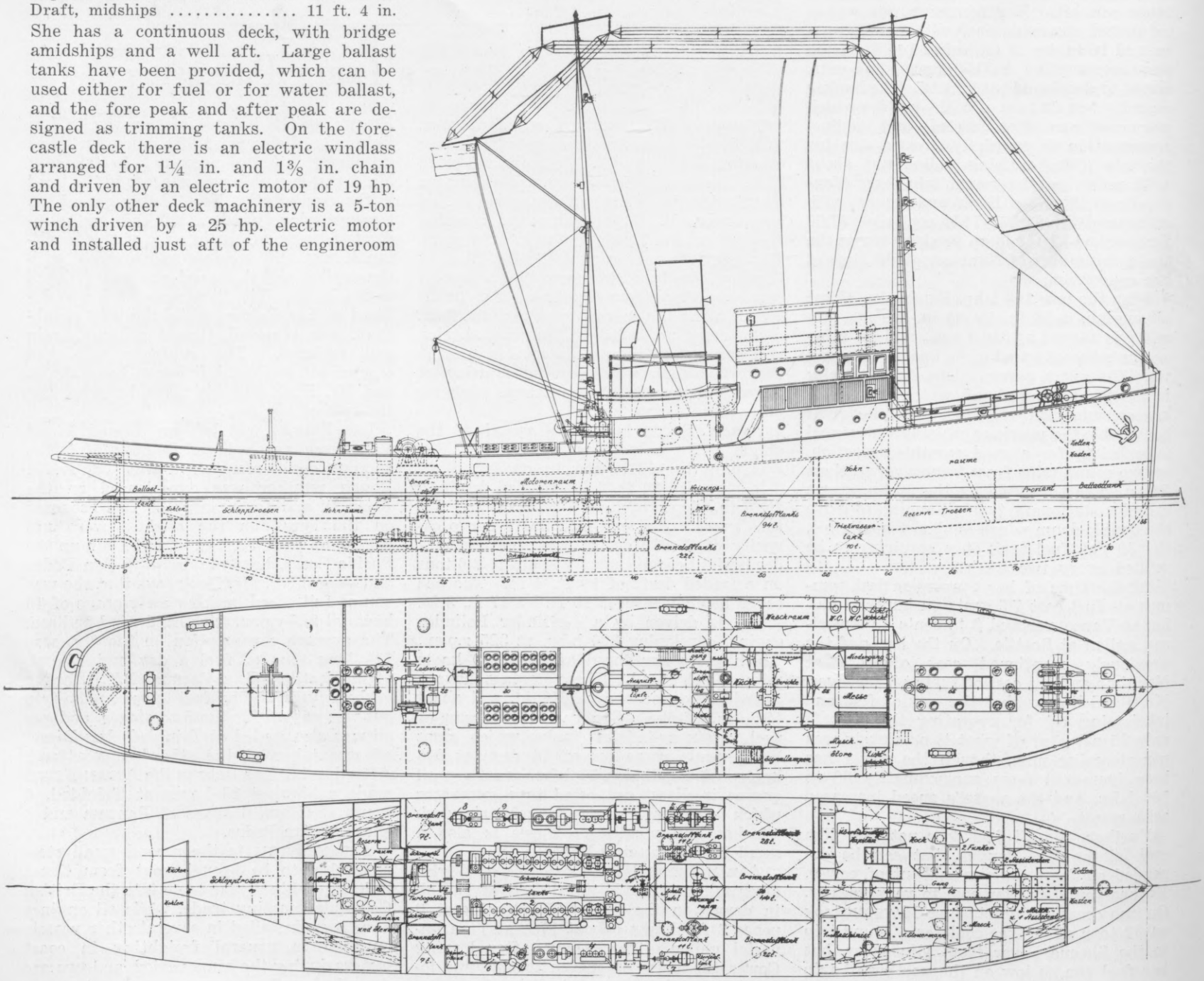
Length, overall	158 ft. 6 in.
Length, b.p.	147 ft. 8 in.
Molded breadth	26 ft. 0 in.
Depth to main deck	14 ft. 3 in.
Draft, midships	11 ft. 4 in.

She has a continuous deck, with bridge amidships and a well aft. Large ballast tanks have been provided, which can be used either for fuel or for water ballast, and the fore peak and after peak are designed as trimming tanks. On the forecastle deck there is an electric windlass arranged for 1¼ in. and 1⅜ in. chain and driven by an electric motor of 19 hp. The only other deck machinery is a 5-ton winch driven by a 25 hp. electric motor and installed just aft of the engineroom casing for handling heavy weights on the derrick. How the accommodation is arranged can be followed from the illustrations presented in this article. There is a total fuel tank capacity of 133 tons, comprising a main tank of 94 tons capacity forward, divided by two longitudinal bulkheads, a 22-ton tank at the forward end of the engineroom and two 7-ton tanks at the after end of the engineroom, together with the day tanks of 3-ton capacity.

The main machinery is of Krupp design and construction, consisting of two 6-cylinder 4-cycle trunk piston engines developing 800 s.hp. at 300 r.p.m., which can be increased to 1175 s.hp. at 336 r.p.m. when the supercharging equipment is used.

These engines are of interesting design. With a view to the reduction of weight, a relatively high engine speed was chosen. With the same end in view the bedplate and framing are of cast steel. Each engine weighs about 33 tons complete.

The designers have provided a rigid construction for the upper part of the engines by bolting all the cylinders together up to the height of the cylinder heads. The crankshaft is in one piece and is considerably oversized for the avowed purpose of withstanding critical vibrations. The compressor instead of being a single cylinder consists of two cylinders with cranks at 180 deg. and the direct connected cooling water and lubricating oil pumps have been arranged next to the compressors, with their cranks arranged at as favorable an angle as possible. This arrangement has also provided self-contained engines, con-



Outboard profile, deck plan and hold plan of Wotan, a powerful ocean type motortug owned by a Hamburg towing and salvage firm

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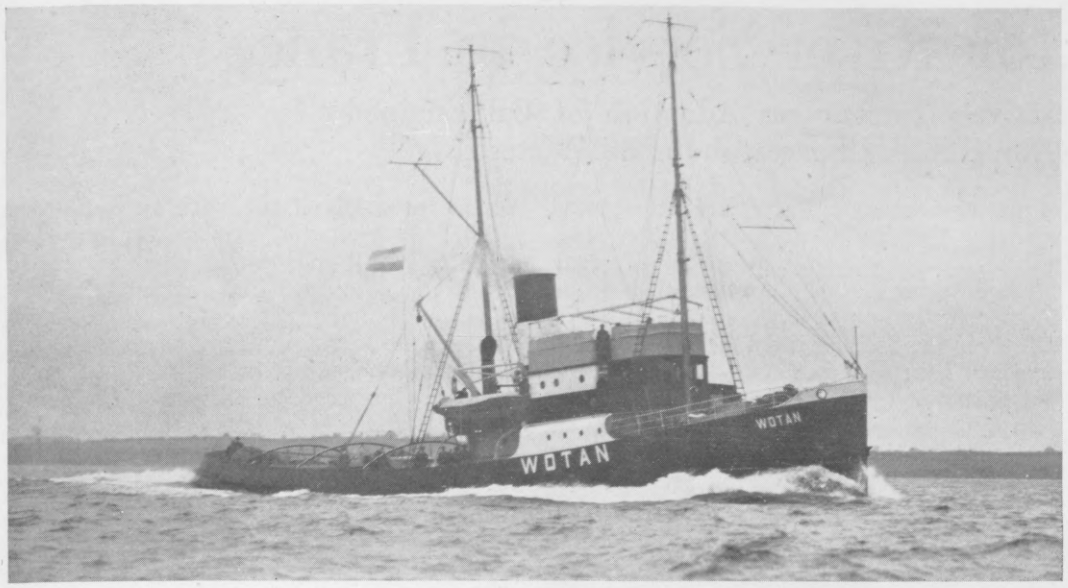


Hamburg motortug Wotan, 2350 s.hp., one of the most powerful towboats in the world

sidered extremely desirable in this case because of the need for a quick response to orders.

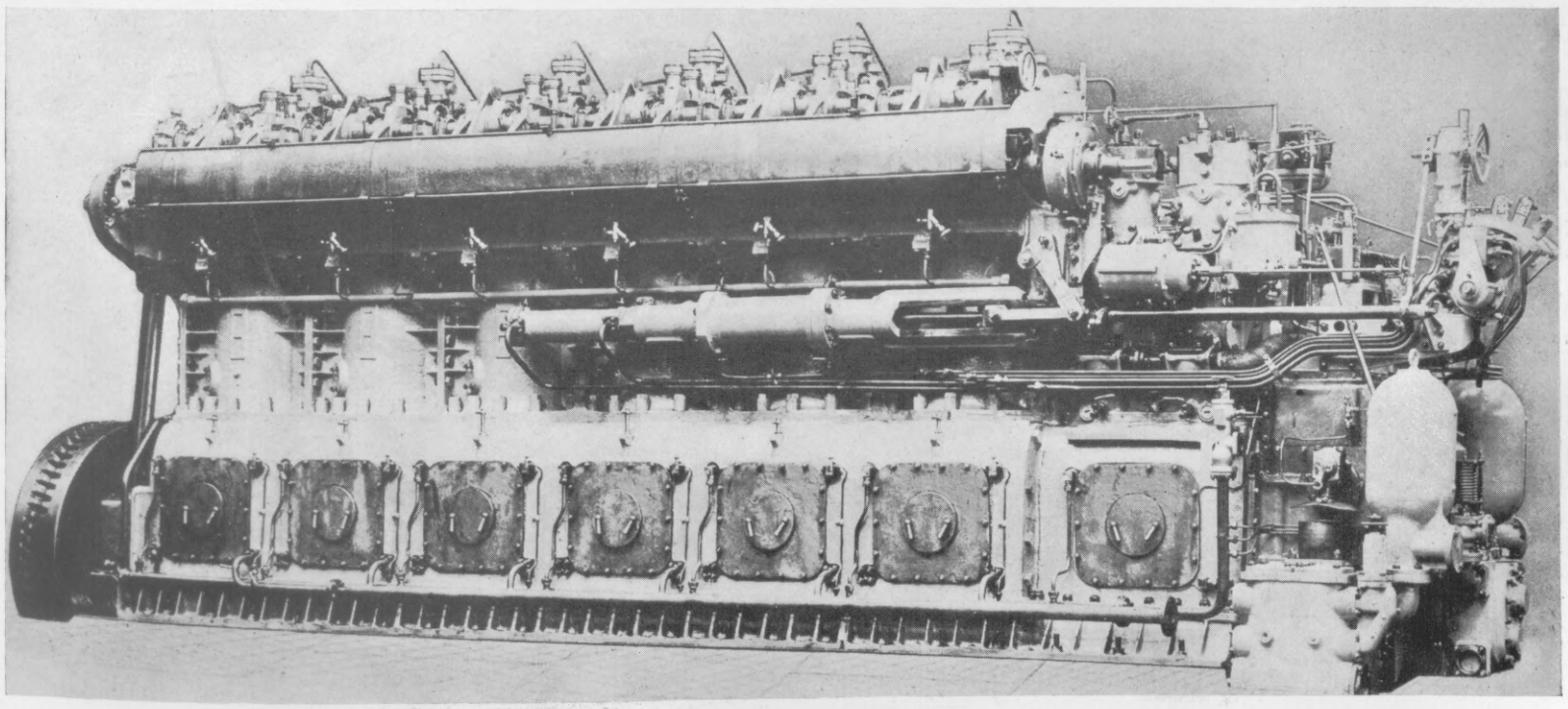
The pistons, as might be expected in a totally enclosed engine of this type, are oil cooled, the use of oil not endangering the satisfactory operation of the forced lubrication. In the cylinder heads one notes that in addition to the inlet valve, exhaust valve and starting valve there are two fuel valves, an arrangement which favors a better cooling and which at higher mean pressures also gives a better fuel penetration in the combustion space. The starting valve is not of the usual type directly operated by a rocker arm. It is operated by a compressed air cylinder in conjunction with a rocker and a cam of negative form. Starting air pressure of 225 lb. per sq. in. is used, and when the engine is being started the fuel pumps are not cut out. As soon as the engine picks up speed a little, firing begins in some of the cylinders, and the starting valve is so arranged that it does not open until the burning gas has expanded below 225 lb. per sq. in. This arrangement is being used on all the reversing engines built by Krupp's and results in a very reduced consumption of starting air, as was shown by the diagram on page 528 of the July 1925 number of MOTORSHIP. This economy of starting air is evidenced even if the engineers themselves are not of an economical turn of mind.

In normal operation the engine suction manifolds are connected to an intake on deck at the after end of the engine room. The supercharging blower is just below, and its discharge can therefore be very readily hooked up to the suction manifolds of the main engines. The turbo blower is driven by an electric motor of about 60 hp., and the supercharging pressure is about 44 in. of water.

For auxiliary purposes there are two 4-cylinder airless injection engines, each developing 50 b.hp. at 420 r.p.m. These are each directly connected with a 33 kw. generator and clutch connected with a maneuvering air compressor. There is, furthermore, a 15 hp. oil engine set connected with a 6 kw. dynamo and with a small emergency compressor. This dynamo provides sufficient power for the light and for the pump service when the tug is in port. All the auxiliary pumps are electrically driven. They consist of an auxiliary cooling water pump with a capacity of 70 tons per hour, an auxiliary lubricating oil pump of 30 tons per hour, two bilge and fire pumps each of 20 tons per hour, one fuel transfer pump of 30 tons per hour and one salvage pump with a capacity of 400 tons per hour.

Tenders for five or six motorships for the Canada-West Indies service were received by the Canadian Government recently. The vessels were to be 410 ft. length, 55 ft. beam and 5800 d.w. tons, with accommodation for 100 1st class passengers, 100 2nd class and also for steerage passengers. Three or four of the vessels were to have 15,000 cu. ft. of cold storage space and a speed of 13½ knots, and the other two were to have 13,000 cu. ft. of cold storage space and a speed of 16 knots.

Official confirmation is now to hand of the contract which the Fairfield Co. and Swan, Hunter & Wigham Richardson, Ltd., have each received for a large passenger liner for the Shaw, Savill & Albion Co., states *Shipbuilding & Shipping Record*. These are to be quadruple-screw ships of about 600 ft. length, driven by Diesel engines of the Sulzer type. For the particular service in which these ships are to be engaged first-class accommodation for a large number of passengers is essential, as also is large capacity for the carriage of frozen meat. Owing to the vast improvement made in the passenger accommodation of vessels recently placed on the Australian service as compared with those built in pre-war times, the new vessels will compare with the best ships on the Atlantic service. The shipping companies are making greater provision for the passenger who is willing to pay for the privacy afforded by the single-berth cabin with the private bathroom attached. The quadruple arrangement has been adopted in the light of the success attending the trial and ocean performances of the *Aorangi*.



One of the 6-cylinder 4-cycle 800 s.hp. trunk piston engines of the Wotan, capable of delivering 1175 s.hp. at 336 r.p.m. when supercharged

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Motortugs for River Service in France

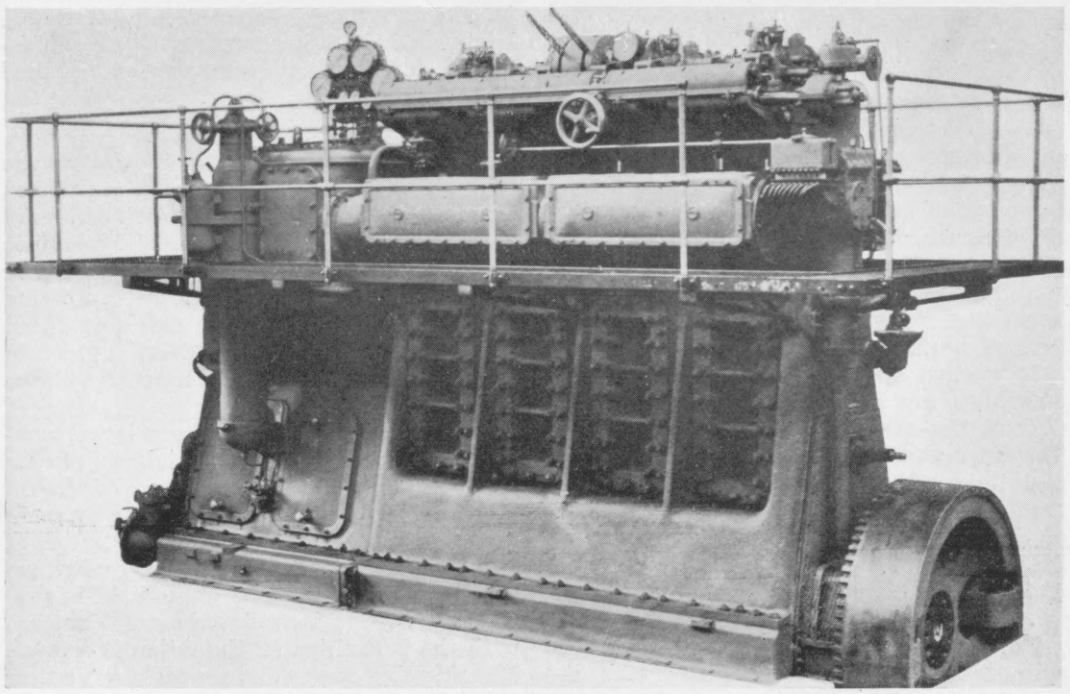
Government Actively Encourages Adoption of Oil Engined Towboats for Hauling Barges on Inland Waterways

THE Office National de la Navigation, a State Department that supervises navigation on waterways in France and initiates development of river and canal services, has done much to back the adoption of the Diesel engine on French river and canal tugs. The first trials in that direction were made in 1919, when the department in question decided to acquire several Diesel tugs engined with Sulzer and Polar motors. The results obtained proved quite satisfactory, and the tugs were later sold to a private company which has been operating them for six years very successfully on the Seine.

In view of the excellent results obtained in service on the Seine with 10 Sulzer-engined tugs, the Société Générale de Touage et de Remorquage, Paris, recently placed with the Compagnie de Construction Mécanique, Procédés Sulzer, an order for four further Sulzer 2-cycle 420 hp. engines to be fitted on four new tugs. That type of 4-cylinder engine is illustrated herewith, while another illustration shows two of these Sulzer engined tugs in service on the Seine.

In addition to the considerable saving in fuel consumption as compared with steam tugs, another important advantage that has been experienced by owners lies in the reduction in staff and also in the possibility of avoiding the employment of firemen. As regards the saving on fuel, it was found that while 30 tons of coal were necessary for the round voyage Paris-Rouen-Paris with a steam tug, 3½ tons of oil were sufficient for a Diesel tug with an equal tow.

Those advantages explain the growing adoption of oil engines for river service in France. It is learned that further trials are to be made under the control of the Office National de la Navigation; while a 150 hp. Chaléassière engine is to be fitted on a tug under construction for use on the Seine, other installations of Diesel engines are being made on several tugs engaged in the Rhine service. This development on French waterways is particularly notable, because hitherto France had been slow to adopt both Diesel engines and power towing.



Main 420 hp. 4-cylinder 2-cycle engine of the French Government's river tugs

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Among recent visitors to the port of Vancouver was the Norwegian motorship THALATTA. This ship is operating on charter and arrived to load a cargo of logs and lumber for Japan. She is one of a fleet of motorships operated by W. Wilhelmsen of Oslo, Norway, was completed in July, 1922, and has a length b.p. of 425.5 ft., a beam molded of 55.2 ft. and a cargo capacity of 10,600 tons including 1,200 tons of fuel. Propulsion is effected by twin 6-cylinder B. & W. engines developing a total of 3,100 i.hp. at 125 r.p.m. and can make a speed of 11 knots loaded in smooth water on a fuel consumption of 11 to 11½ tons a day for all purposes, the main engines using an average of 10.7 tons. Mr. T. H. Lie, chief engineer, says that running light she will do 12 knots, the engines being opened up to 130 r.p.m. On the run over from Yokohama to Seattle, where she put in for bunkers, gales were experienced for 17 days, principally on the port beam and port quarter. As the ship was light it was a good test of the governors in checking the racing of the propellers, which the chief engineer says they did very satisfactorily after minor adjustments were made. An average speed of 10½ knots was maintained in spite of the bad weather. THALATTA has all-electric winches and auxiliaries.

Touques, one of the first ten Diesel engined towboats on the River Seine, with five barges in tow. Another Diesel towboat astern

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M. A. N. Double-Acting 2-Cycle Engine

Principal Features of the Latest Development of Diesel Engine Design by the Pioneer Diesel Firm

DEVELOPMENT of the double-acting 2-cycle engine by the Maschinenfabrik Augsburg-Nürnberg, the pioneer builders of Diesel engines, has been recorded from time to time in the pages of MOTORSHIP. Through the courtesy of the German firm we were enabled to publish in 1923 the first detailed description of the big double-acting engine built more than 10 years ago in the hope that it would permit Germany to spring a surprise in naval architecture by the introduction of the Diesel engined battleship.

That big engine, rated nominally at 12,000 hp., actually developed 17,150 s. hp. on a sustained overload. It had 6 cylinders of 33½ in. diameter, and with a piston stroke of 41⅜ in. was designed to turn at 160 r.p.m. When the final tests were made on it in 1917 it was in a satisfactory form, but the German naval authorities had their hands full with another problem and left the big engine.

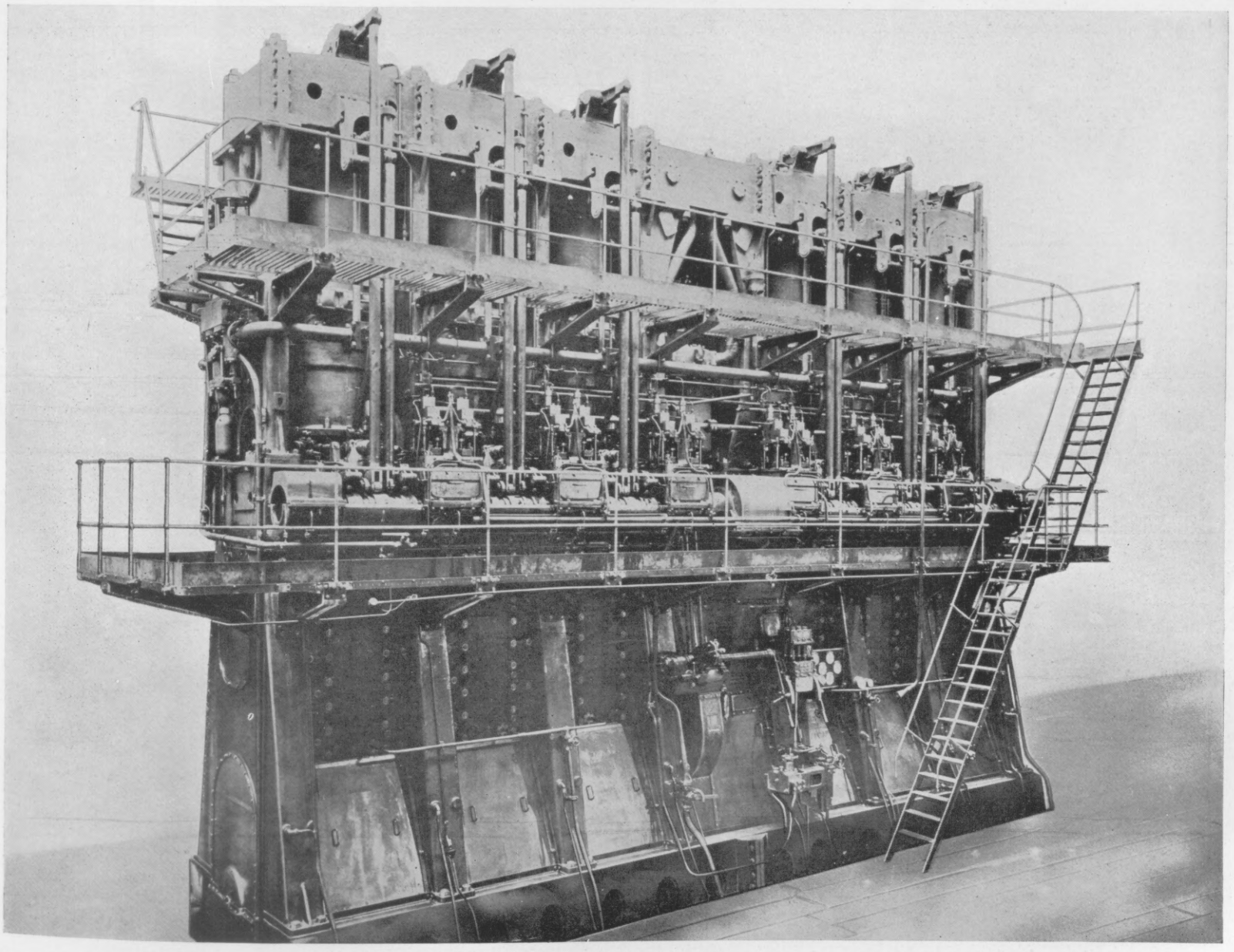
Under the terms of the Versailles Peace Treaty the allies required the Germans to destroy the engine. Development of this type of engine by the M.A.N. was not, however, arrested. All the Diesel engine work of the company was transferred to Augsburg, the designing staffs of the two plants at Nürnberg and Augsburg were merged and a new start was made.

The chief departure from the earlier lines of progress was the abandonment of the scavenge valves in favor of scavenge ports. About two years ago a 1200 b.hp. single-cylinder unit of the port scavenging type was tried out in Augsburg, and led to satisfactory results. Since that date, Blohm & Voss, one of the M.A.N. licensees has built a 15,000 b.hp. engine of this type for installation in a central power station in Hamburg. Several M.A.N. double-acting engines, but of considerably lower power, have been completed during the last few months for German vessels. Two engines of this type, both of about 3000 s.hp., are being built for the U. S. Shipping Board, one by the New London Ship & Engine Co. and the other by the Hooven, Owens, Rentschler Co.

In the latest design scavenging is carried out as shown in the diagram on page 368, the scavenging air entering through a duct serving the middle of the cylinder and passing through independent ports in the cylinder walls to the upper and lower cylinder ends, being directed in such a manner that it sweeps across the piston face to the far side of the cylinder. Guided by the cylinder wall it returns from the combustion space, pushing out the exhaust gases through exhaust ports adjacent to the scavenge ports.

All the ports are on one side of the cylinder unit, this arrangement having been found the most efficient in a long series of tests conducted with models and all directed to the purpose of obtaining as good a scavenging effect from the 2-cycle engine as the 4-cycle type obtains by actual piston scavenging.

In the design of engine frame the same features can be noted that have of late



Double-acting 2-cycle engine for the German single-screw freighter Ramses, developing 4400 b.hp. at 84 revs. per. min.

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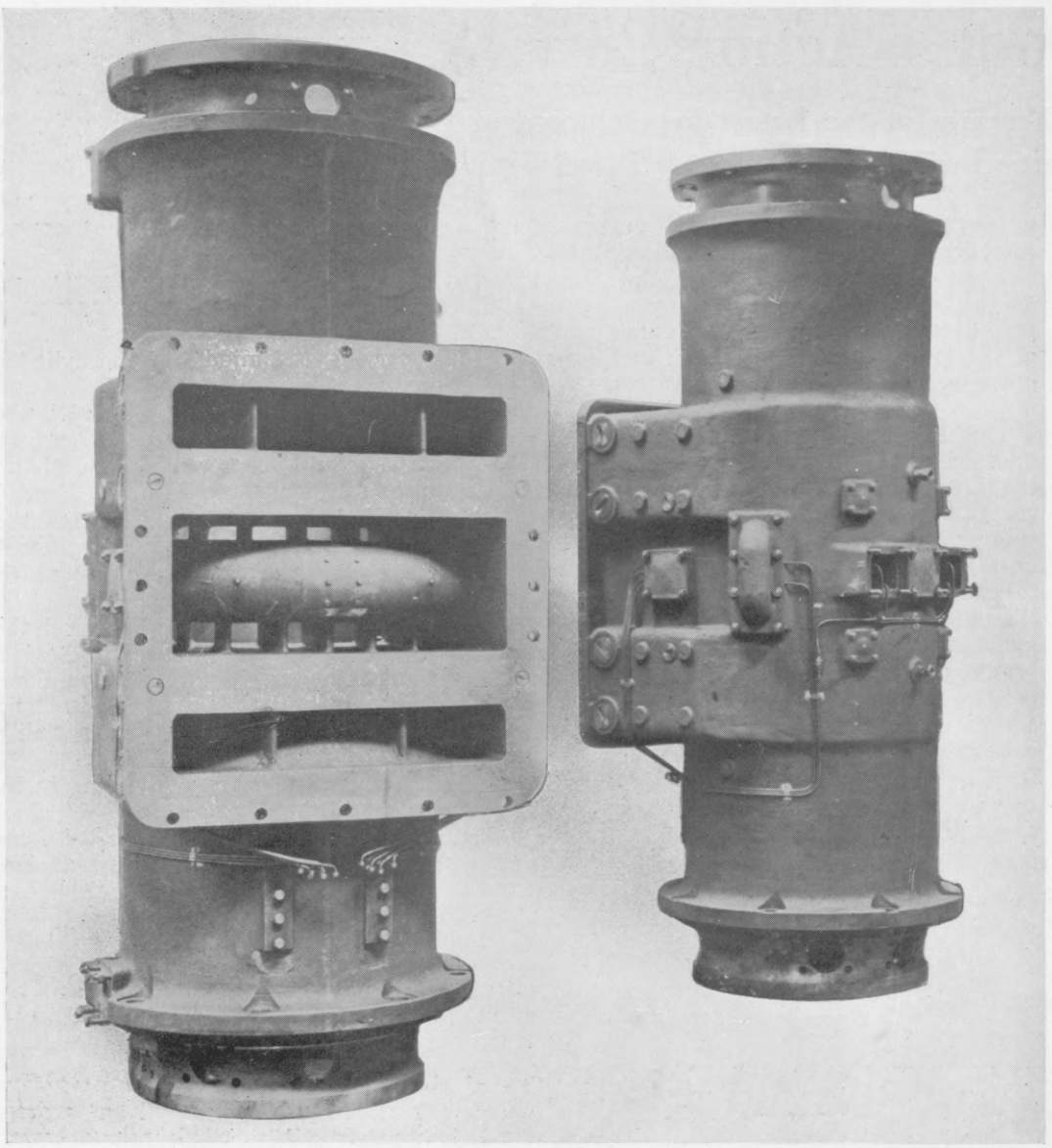


Cylinder liners with scavenge ports for upper and lower ends and corresponding exhaust ports

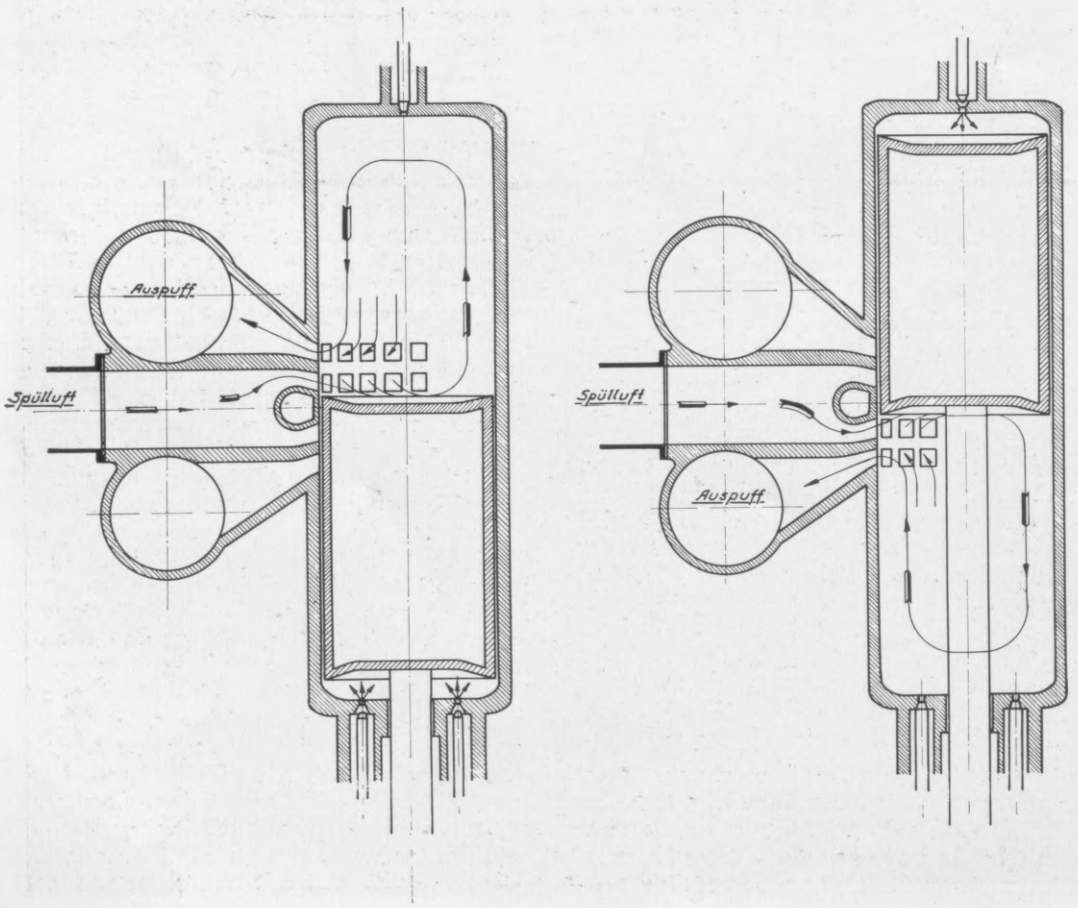
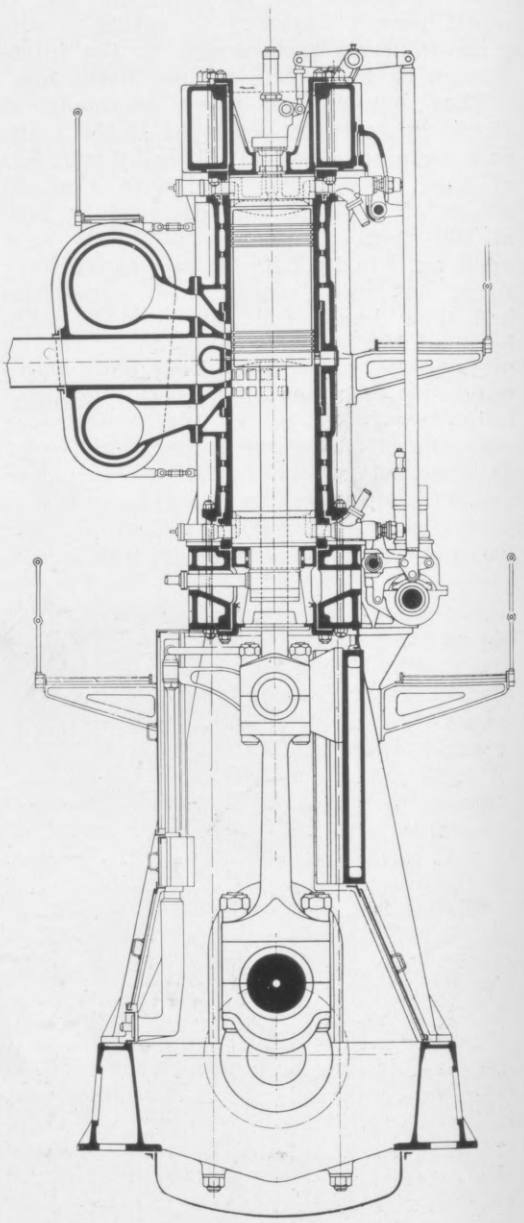


Diagram of path of scavenge air through the top and bottom ends of the double-acting cylinder

years characterized all M.A.N. practice. The crankchamber is of rigid construction, consisting of A frames firmly bolted together and surmounted by an entablature to which are bolted the cylinder castings, on top of which are the cylinder heads firmly bolted together from end to end of the engine, forming a girder. Tie-rods extend downward from the heads to the bedplate in way of the main bearings. The lower cylinder covers are bolted to the entablature, to which the cylinder jackets also are fastened. No tensile stresses are transmitted through the framework, the forces being carried from the cylinder heads to the main bearings through the steel rods. The forces acting on the lower



Section through double-acting engine

cylinder covers impose only compression stresses and these are transmitted directly through the frame.

Freedom of expansion for the liner is allowed. This liner consists of two equal parts, an upper and a lower. Where they meet at the middle of the cylinder they are fitted sawtooth fashion in order not to present any horizontal edges to the piston rings. This detail of construction is not shown in the drawings accompanying this article, but has been fully explained in earlier descriptions of the M.A.N. double-acting engine published in MOTORSHIP. The lower liner is bolted to the entablature while the upper liner is attached to the

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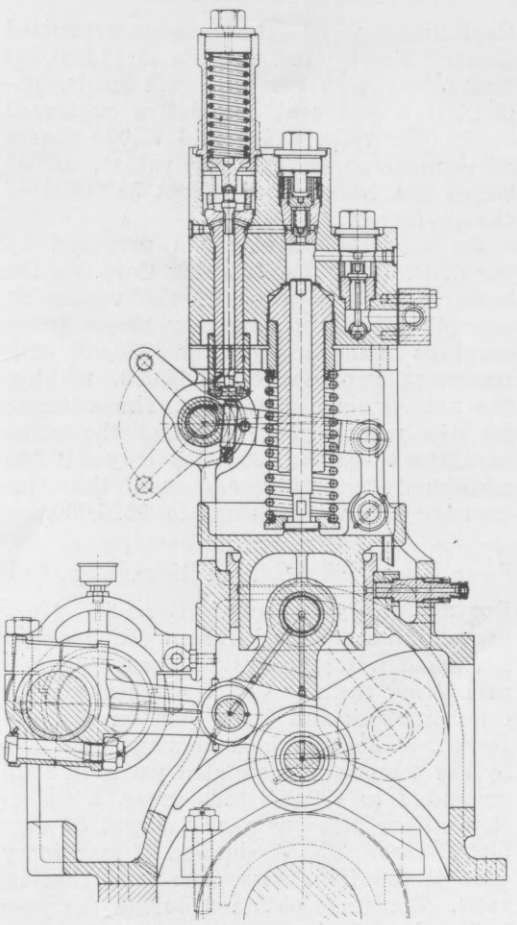
cylinder head. Expansion, therefore, can take place at the middle joint without giving rise to any stresses in the jacket.

In the cylinder head is seen the evolution of the idea originated by M.A.N. a good many years ago of having a separate part for taking care of the heat stresses and an outer cover for resisting the mechanical stresses. The inner cover is generally referred to as a heat shield and is just a shallow water cooled drum. The outer cover is entirely uncooled and serves not only for holding the fuel valve, but is made deep enough to act as a member of the rigid girder formed at the top of the engine by bolting all the heads together. This latest feature of design shows very clearly in the view of the top cylinder covers and valve gear.

The fuel valve is in the center of the head and is the only valve in the head proper. The starting valve and the relief valve are fitted horizontally in the upper part of the cylinder, and recesses for them are formed in the heat shield. In the lower cover the 2-piece construction is also practised, but the outer cover is not made deep because rigidity at this part of the engine is furnished by the entablature. Through the two parts of the lower cover of course passes the piston rod, for which a water cooled stuffing box is provided in the outer cover. This stuffing box prevents a central fuel valve being used, and in place of it are found four small horizontal fuel valves, slightly offset from the cylinder diameter in order to give a good distribution of fuel without the sprays impinging upon the piston rod.

A starting valve and a relief valve are fitted in the lower cylinder end in the same manner as in the upper cylinder end.

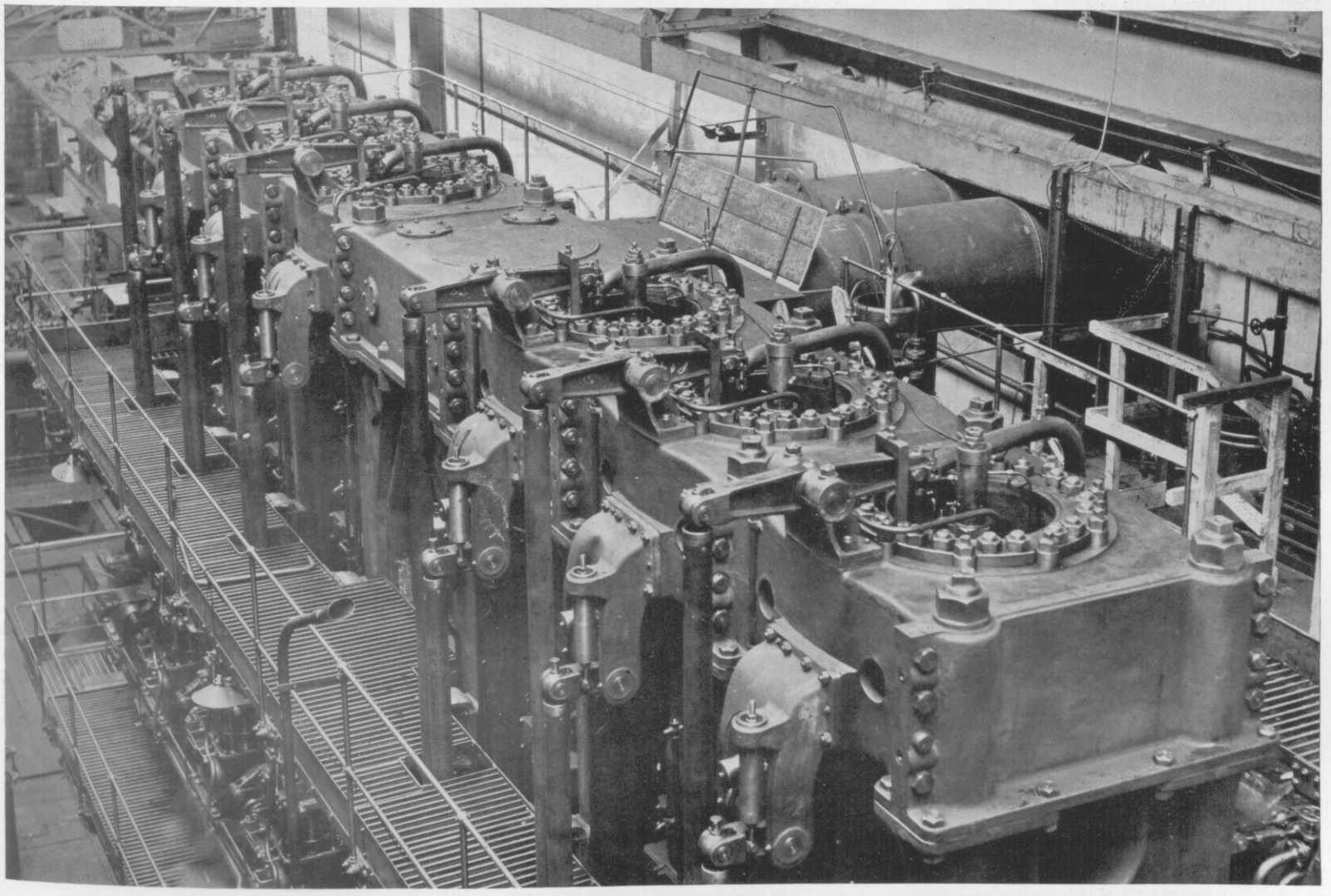


Details of fuel pump and drive

For operation of the valves there is a single camshaft extending along the entablature and driven from the crankshaft through an intermediate shaft by means of gearing. On it are arranged separate ahead and astern cams for the fuel valves and starting valves, the valves in the cylinder head being operated by push rods and those in the lower end by bell cranks. For reversing, the camshaft is moved longitudinally in order to carry the desired set of cams under the respective cam rollers.

A feature of the starting valves is that they are arranged to stay shut during all periods when the pressure in the cylinder exceeds the pressure of the starting air supply. With this precaution it is deemed permissible to allow the fuel pumps to operate during the starting period. Each cylinder has two fuel pumps, individual units fitted very accessibly just above the entablature and directly above the camshaft. These pumps act on the 35-year old principle adopted by Lauster in Augsburg when he was building the first commercial Diesel engine that was ever constructed; that is to say, the fuel pump stroke is constant, but the amount of oil supplied to the fuel valve is determined by the moment at which the by-pass valve to the suction closes on the delivery stroke.

The design of the fuel pump on the latest double-acting engines, however, is such that the delivery of fuel from the pump to the injection valve is timed to occur immediately prior to the period of injection into the combustion chamber. This is a safeguard against fuel entering



Upper grating of the M. A. N. 4400 b.hp. double-acting engine, with cylinder head castings bolted together to form a girder

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into the cylinder at wrong periods during the maneuvering, as might otherwise happen with the fuel pumps always working, as they are on this engine, even during the periods when starting air is being admitted to the cylinders. The driving mechanism is so arranged that the cam roller is lifted, while the camshaft is being moved from the ahead to the astern position. To take care of the four fuel valves in the lower covers a distributor is added to the fuel supply system of the lower end so that the amount of fuel fed to the lower combustion chamber is equally divided between the four valves.

This general design of valve arrangement lends itself to very simple controls. There is a lever controlling the amount of fuel furnished by the pumps to the cylinders, a lever for maneuvering and a lever for controlling the compressor air supply. The maneuvering lever regulates the admission of starting air as well as the operation of the camshaft sliding device.

Reverting to the general structure of the engine, attention may be drawn to the arrangement of the six cylinders in two groups of three cylinders with space between for the air compressor. The bedplate is in two sections, but the entablature consists of only a single casting. The girder at the top of the engine is bridged across the middle space by means of a spacer of the same deep and rigid section as the cylinder heads between which it is bolted. Stiff webs extend between the entablature and the top girder. The crankshaft is of the built-up type, each crankpin with its two crank webs being a separate forging. Three stages of compression have been adopted in the air compressor, the first stage being double-acting and the second stage formed in the annular space between the piston and the two cylinders. For the supply of scavenging air this particular engine is arranged for operation with independently driven blowers. Forced lubrication is, of course, used throughout, and the only other important detail of which mention need be made is that water is used for the piston cooling.

The 6-cylinder engine depicted in the accompanying illustrations was built for the motorvessel RAMSES of the Deutsch-Austral & Kosmos Lines. Its six cylinders of 27.56 in. diameter and 47.24 in. stroke develop 4400 b.hp. at 84 r.p.m. It weighs 485 tons with flywheel, barring gear, air injection system, scavenge manifold and exhaust manifold. An additional 10 tons must be added for the two electrically driven scavenge pumps and a further 9 tons for the cooling water and lubricating oil pumps. The MAGDEBURG, also belonging to the Deutsch-Austral & Kosmos Lines has been in service for a few months and operating very satisfactorily. A 5200 b.hp. engine is being built by the Fijenoord firm in Holland for the Rotterdam Lloyd Line. Two engines of 4000 b.hp. each at 76 r.p.m. are being built by the A. G. Weser in Bremen for two vessels ordered by the Hansa Line. In Augsburg four engines rated at 6250 b.hp. at 120 r.p.m. are being built for the 31,000 tons motorliner now building at the Ansaldo yard in Italy for the Navigazione Generale Italiana. To these engines under construction one must add the two engines building in this country for the Shipping Board.

Financial Notes

Electric Ferries, Inc.

Capitalization of the newly organized Electric Ferries Inc. consists of $1,500,000 first mortgage 7 per cent gold bonds, $1,000,000 8 per cent cumulative preferred stock (par value $100) and 75,000 shares of common stock (no par value), all of which has been issued except $300,000 of the preferred.

An estimate of earnings prepared by the J. G. White Engineering Corp. on the basis of the operation of the vessels at only 42½ per cent capacity shows gross earnings in the first year of $850,000 with operating expenses of $365,000, making the net earnings $485,000. The estimate for the second year increases the gross earnings to $1,000,000 with only $10,000 additional operating expenses, thus increasing the net earnings to $625,000.

Swan, Hunter & Wigham Richardson, Ltd.

During the year ended Dec. 31, 1924, Swan, Hunter & Wigham Richardson, Ltd., had net earnings of about $997,800 permitting them to pay 7 per cent on the common stock and 6 per cent on the preferred. The combined tonnage launched by the company's associated yards in 1925 amounted to 132,228 tons gross, a reduction on the previous year's output of over 50,000 tons. The production of machinery was 48,450 i.hp., less than half that of 1924. Contracts obtained during the year had to be taken without profit in order to keep open the more important of the company's works, only three of which are now in operation.

Lamport & Holt, Ltd.

Results of this company for 1925 show net profits for the year amounting to $867,755 as compared with $588,070 for the year 1924. From the reserve a sum of $250,000 was withdrawn to help write off $1,000,000 from the shipping investments. No dividend was paid on the common. The trades in which the company is interested continued to be detrimentally affected by the general depression in shipping. No changes took place in the company's fleet during the year.

Fried Krupp Akt. Gesellschaft

For the year ending Sept. 30, 1925, the Krupp Company showed a loss of $3,641,400, largely due to operations at the Germania shipyard. The engineering department of the yard was able to work without losses, but the building costs of a number of hulls exceeded the contract prices to such an extent that a special write-off of $1,666,000 was considered advisable. The shipbuilding losses were due mainly to the building of a number of large oil tankers for the Standard Oil Company on orders taken two or three years earlier.

Det Forenede Dampskibsselskab A/S

For the year ending Dec. 31, 1925, the United Shipping Company of Copenhagen, made a gross profit of about $1,934,292. After deduction of expenses of administration, interest and staff pensions, the net profits amounted to about $340,007, compared with a corresponding figure of $915,997 for last year. The American 6 per cent dollar loan of $5,000,000 has been brought down to $4,558,500. The Company is the largest shipping concern in Denmark and includes in its 221,434 aggregate gross tonnage six motorships.

East Asiatic Co. of Copenhagen

The report of the Danish East Asiatic Company for 1925 shows a profit of $969,400 less than in 1924. The accounts showed a surplus of about $4,701,848. A dividend of 14 per cent was paid. At the end of the year, the company's fleet consisted of 22 motorships with a loading capacity of 179,220 tons. These are now booked at about $43 per ton deadweight after depreciation has been written off. The average age is just over 7 years. The company possesses a reserve fund of $13,100,000, the same amount as the share capital, besides a contingency fund amounting to $3,144,000.

A/S Borgestad

The Borgestad Company of Norway made for the year ending Dec. 31, 1925 a net profit of $149,371, and declared a dividend of 10 per cent. The company has under construction three motorships of 8450 tons d.w., one at the Burmeister & Wain yard, Copenhagen, and two at Götaverken. Owing to the rise in the value of the Danish krone, loss was suffered on the new tonnage constructed in Denmark, while on the other hand the rise in the Norwegian krone increased the value of two ships under construction in Sweden. According to the contract, one third of the price is to be paid in cash while the balance can be paid five years after the delivery of the ships, an arrangement which, if the Norwegian krone increases in value, will be advantageous to the company.

Burmeister & Wain

The 1925 income statement of Burmeister & Wain, Ltd., of Copenhagen, sent to the New York banking group which brought out the $2,000,000 bond issue last year, shows that net income before depreciation and taxes was equal to 4.46 times the interest charges. Results for the year are regarded as satisfactory in view of the fact that the company was handicapped in the earlier part of the year by a three month general strike. Net income available for reserves amounted to $1,083,993, compared with $991,090 in 1924. Last year the management set aside an unusually large reserve, so that although 1925 net income was larger the surplus after all charges was only $230,687, as against $452,675 for 1924. Reserves totaled $610,006, against $240,350 in the preceding year. The report points out that since the $2,000,000 loan was floated the rate of krone exchange has advanced about 38 per cent. This improvement in the rate has brought about a substantial decrease, as expressed in krone, of the amounts payable for principal, interest and sinking fund of the loan.

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Advice on Diesel Engine Lubrication

A Review of the Qualities of Oil Demanded for Different Parts of the Engine

By Wm. V. Fitzgerald *

IN DIESEL engine operation, the most essential objective is reliability with economy. Efficient operation is the keynote of the profitable use of this highly developed type of propelling unit. Continuous motive power, which is necessary to efficiency, is dependent upon the maintenance of the engine on a high plane of mechanical excellence. Operating costs are increased by every condition which contributes to the increase of frictional losses, delays or shut-downs. A large percentage of troubles resulting in frictional losses and shut-downs, encountered in the operation of Diesel engines, can be traced to the use of unsuitable lubricants.

The problem of lubricating the Diesel engine in any field of service is one which requires a satisfactory solution in order to effect continuous and reliable operation of the engine. In no field of service is continuous and reliable operation more necessary than in marine work. Failure on the high seas resulting from the development of trouble in the cylinders, the bearings or the air compressor, presents a hazard to life and cargo. The prevention of these troubles and the accompanying losses incurred by them, lies to a great extent in the selection of lubricating oils that will meet the special requirements of Diesel engine work.

The importance that should be attached to the selection of the right oil, and the emphasis that should be placed on the scientific application of this oil, cannot be overestimated. In stressing these points, it is necessary to state that precaution against sudden failure is not the only object of correct lubrication. Equally great is the prevention of gradual depreciation and wear of the engine.

The Diesel engine lubrication problem may be conveniently placed under three distinct heads: Supplying lubrication to the cylinders; supplying lubrication to the bearings; supplying lubrication to the air compressors. The analysis of each of these phases of lubrication, with some exceptions, is a distinct problem, involving factors which are peculiar to each phase.

Cylinder Lubrication

The problem of efficient lubrication of the power cylinders of Diesel engines is the furnishing and maintaining of an oil film on the cylinder walls under the existing conditions of high pressure and high temperature which result from the combustion of the fuel inside the cylinder.

Final compression pressures of 500 lb. per sq. in. and gas temperatures of over 3000 deg. F. during the period of combustion, are such severe conditions as to tax the lubricating property of the oil to a maximum.

The parts subjected to these conditions and to which the term "cylinder lubrication" applies, are the power cylinder and piston. The surfaces to be lubricated are the cylinder wall, piston body and piston rings.

In some engines, the piston pin, which is subject to high temperature due to its enclosed location, poor radiation of heat, heavy pressure as well as the slight pendulum motion of the connecting rod, must also be considered along with the cylinder lubrication.

Easy operation of valves is necessary for the efficient operation of the engine, and although these are not a part of the cylinder proper, lubrication must be provided also for the exhaust valves in the case of four cycle engines.

Power cylinders of Diesel engines are lubricated by means of a mechanical lubricator which can be adjusted to deliver a uniform quantity of oil at a regular rate of feed. Several leads are usually employed to conduct the oil to the cylinder walls, the number depending on the size of the cylinders. Sometimes provision is made for lubricating the piston pin by the same means, although the piston pin may be lubricated by the bearing circulation system.

The mechanical lubricator consists of a number of small independent plunger pumps in a single housing, each having a pipe or tube to conduct the oil to the desired point of introduction. It is preferable to have each of these leads supply one point only, because if two or more points are supplied by the same lead, it is difficult to equalize or apportion the supply of oil.

The leads for the cylinder should be so arranged as to introduce the oil between the first and second piston rings when the piston is at the bottom of its stroke. In this way the piston acts as a distributor of the oil over the entire surface of the piston and cylinder walls. Separate leads are used to conduct oil to the exhaust valve spindles or drip feed cups may be employed for this purpose.

Diesel Engine Cylinder Oil

In selecting the most suitable oil for power cylinders of Diesel engines, the aim is to supply an oil which will furnish a film on the cylinder liners and piston rings. This oil should protect the surfaces and prevent metallic contact between the piston rings and cylinder liner under the existing conditions of extremely high temperature and pressure.

The part of the cylinder which is most subject to wear is the top of the cylinder liner in the case of single-acting Diesel engines, and also the bottom part of the liner in the case of double-acting engines. This is where the combined effect of the highest pressure and temperature must be encountered. It is also the point where the speed of the piston is at a minimum. The temperature of the cylinder liner at this point is very high, but decreases rapidly as positions away from that zone are reached. While in the zone of high temperature, the piston rings, especially the top ring, are forced out by the high pressure against the cylinder liners and it is only the existence of a tenacious lubricating oil film under these conditions which prevents metal-to-metal contact and excessive wear. The oil film is naturally thinned out by the temperature existing at this point.

To obtain efficient and economical lubrication, it is necessary to create and maintain an oil film with as few drops of oil per minute as possible. The correct oil to be used under these conditions, considering the maintenance of an oil film only, would be an oil which, due to its high flash point and heavy body, would not be thinned out and would be able to maintain a film over a long period against the combined effect of high pressure and high temperature.

Other factors enter into the selection of an oil, however. These are—the distribution of oil around the cylinder liner, the formation of carbon deposits and excessive piston drag. These considerations have made it necessary to use an oil somewhat lighter in body to assist in easier distribution, a minimum of carbon deposits, and a lower fluid friction.

As Diesel engines of larger size come into use, this problem will increase in importance, for larger horsepower per cylinder will require thicker cylinder liners. This will result in the temperature of the cylinder liner being considerably higher and in a further tendency to thin out the oil. Diesel engine cylinders of the large double-acting type and engines of extremely large size require a heavier oil than the average single acting engine.

The amount of oil fed to the cylinders is also very important. Too much oil will give rise to carbon trouble even when a high grade oil is used. Such excess oil is subject to decomposition, and will bake and harden between the piston rings, impeding their proper functioning.

Unsuitable oil in Diesel engine cylinders is often the cause of serious trouble, not only in its failure to form and maintain a perfect film, and its tendency to carbonize, but by reason of its actual failure to prevent metal-to-metal contact between the piston rings and cylinder walls. Wear is most likely to occur on the upper part of the cylinders exposed to the most severe operating conditions and will be aggravated by the use of an unsuitable oil. Engine overheating and loss of power will inevitably follow the breakdown of the oil under high temperatures, and if the condition continues, seizing of the piston may occur.

Overfeeding of oil when using an unsuitable oil is usually necessary. This condition, as mentioned above, is a sure method of forming deposits in the cylinder. It is more. Some of the over-supply of oil will reach the crankcase, carrying with it, car-

* Member of the Technical Dept., Vacuum Oil Co.

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bon and nonconsumed fuel from the combustion chamber. This will contaminate the bearing oil system which will be subjected to additional demands as to its purifying and filtration facilities that will render their care more difficult and tend to lower efficiency in normal operation.

Results of Effective Cylinder Lubrication

The use of an oil especially adapted to the requirements of Diesel engine cylinder conditions will eliminate many of the troubles common to Diesel engine operation.

The efficient use of such an oil will reduce to a minimum the tendency to carbon formation and deposits. It will promote the maintenance of the necessary compression pressures. It will enable the full effort of each power-stroke to be delivered to the crankshaft for useful work.

Excessive wear of the cylinders and piston rings, which cause a decrease in the efficiency of the engine, will be practically eliminated when the correct oil is rightly used, and labor charges and repair costs will be materially lessened. Continuous, reliable and efficient operation of the engine will result.

Bearing Lubrication

Bearing lubrication presents a totally different problem to power cylinder lubrication. Heavy pressures prevail, and the oil is always subject to contamination with water and other impurities. A pressure circulation system is the usual method of lubricating the bearings of Diesel engines. This system uses a circulating oil pump driven by the engine, which delivers the oil under pressure to the main bearings and through ducts to the crankpins, piston pins and other parts requiring lubrication. The oil after passing through the bearings drops back into the crankcase from which it is pumped to a separator or other purifying device, from which the oil is again recirculated through the system. Water cooling coils are often used in circulation systems to dissipate the heat acquired during circulation through the system. This keeps the oil at or near a constant, moderate temperature.

The gravity circulation system is employed on smaller engines. This system does not supply oil under pump pressure, though the oil circulation is continuous and automatic.

The mechanical force feed lubricator is used on some of the smaller Diesel engines for the bearings as well as for the cylinders. Oil so fed to the bearings is usually recovered from the crankcase of the engine, filtered and returned to the mechanical lubricator for re-use.

Bearing Oil for Diesel Engines

The conditions of service and the requirements being very different, it is not necessary, and in many cases inadvisable, to use the same oil in the bearing system that is used for the cylinders.

A high grade oil is necessary. The oil in its continuous circulation through the various bearings is always subjected to very high pressures and comparatively high temperatures every time it is drawn into the pressure area in its passage through the bearings, while the throwing about of the oil in the crankcase after escaping from the bearings brings about the possibility of oxidation.

In addition, it is necessary that the oil separate quickly from water and other impurities with which it is liable to become contaminated. Unsuitable oils, not specially manufactured for such conditions, will very soon deteriorate and are then liable to form deposits which will gather in the narrow oil passages in the cranks, connecting rods, and bearings and accumulate to such an extent that the passage of the oil may suddenly stop.

It is, therefore, necessary to select an oil suitable for continuous use in a circulation system, and having a body sufficient to meet the operating conditions with regard to temperature and pressure.

There is, however, another condition which must be kept in mind, namely, that in many instances the pistons of large Diesel engines are cooled by the same oil which is used for bearing lubrication. This naturally results in higher temperatures of the oil in circulation which would further tend to decrease the viscosity of the bearing oil.

Again, in this case, the worst operating conditions which may be experienced must be considered, namely, where the temperature of the atmosphere as well as the temprature of the cooling water is high, for example, when operating in tropical waters. What the temperature of the returning oil may be under the most extreme conditions is difficult to say as this depends, of course, a great deal on the quantity of heat taken up by the oil on its passage through the piston, the total amount of oil in circulation and the efficiency of the cooling apparatus in service. The foregoing would clearly indicate the necessity of an oil of somewhat heavier body.

Impurities in the Oil

Impurities represent one of the problems of lubricating oil circulating systems. Such impurities may come from several sources.

In some types of engine, the lubricating oil from the cylinder drips into the crankcase, bringing with it carbon that has worked past the piston. This carbon may consist of broken down lubricating oil or it may consist of deposits resulting from the incomplete combustion of the fuel. In some types of engines, carbon from the interior of the piston falls into the crankcase. The effect of these impurities is to clog the passages, oil leads and otherwise to hinder the free circulation of the lubricating oil.

Solid particles from whatever source must be settled out or removed by separation, else they will find their way into the bearings with a comparatively thin oil film and cause serious wear.

Water in the system is equally dangerous to its efficient working. Water may be caused by condensation within the crankcase or it may leak in directly from the cylinder water jackets above. In either case, it should be removed promptly. The presence of water in the system may cause the formation of emulsion and finally sludge which may stop up the leads and passages and result in the failure of the oil circulation system.

It is necessary, therefore, to select an oil for use in a circulation system which will easily filter or separate from impurities. It should be a high grade, straight mineral oil, refined to resist sludge formation and emulsion, capable of long service under severe pressure and temperature conditions.

Oil Recovery

Circulation systems are generally provided with some means of freeing the oil from impurities during its cycle of service. The filter or separator should be capable of removing the water that becomes entrained with the lubricating oil and also the solid impurities that might cause wear and abrasion of the bearing surfaces. The removal of metallic particles is especially desirable because of their effect in forming sludge in the presence of water.

Results of Correct Lubrication

In a circulation system of any kind, or in a system where the lubricant is re-used continuously, only oils of highest purity will give satisfaction. The oil must be of the right viscosity to form and maintain a complete film at all times under the conditions of temperature and pressure existing in the engine.

The oil must be of such a nature that it will resist the tendency to break down under severe service. It must resist the effect of water and other contamination and have the correct characteristics to make it easily and completely separable from impurities.

The results of the selection and use of such a high grade lubricant will be to increase the efficiency of the engine, by promoting continuous and uninterrupted operation, and reducing the cost of repairs and renewals to a minimum.

Air Compressor Lubrication

Injection air compressors work up to about 1,000 lb. per sq. in. pressure, and although the volume of air used is comparatively small, the high pressure must be maintained. This pressure is obtained usually in three stages of compression, a differential piston being the common construction.

Mechanical force feed lubricators are used to supply oil to the air compressor cylinders. The purpose of the oil is to provide an oil film for the piston body, rings and cylinder walls of the air compressor in order to maintain a piston seal. Under the very high pressures, an oil of great lubricating value is essential.

Some compressors have leads to only one or two stages of compression, while in the larger sizes leads are provided for each stage. The oil is spread by the moving piston over the piston surfaces and cylinder walls.

The air compressor oil should be a high grade, specially compounded oil of sufficient body to maintain the sealing and lubricating film under the conditions of high temperature and pressure existing in the cylinder.

Free air contains a percentage of moisture or water vapor and when the hot compressed air is cooled in the intercooler, a part of the condensed water vapor from the intercoolers is carried along with the air into the next stage of the compressor.

This moisture washes away the lubricating oil film and leaves the cylinder walls and pistons without protection, unless the oil has special resistive powers. The formation of rust follows the lack of a complete oil film when water is present. Plenty of oil may be present in the cylinder to effect proper lubrication, but still the oil film may be incomplete. Under such conditions,

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wear will occur especially in the final stage cylinder where lubrication is most necessary due to the extremely high pressures.

High temperatures in the presence of very high air pressures will break down an oil that is not especially manufactured for the work. The formation of carbon under these conditions when using an unsuitable oil is certain to cause trouble from deposits in the air passages and on the valves. The friction of the compressed air passing through restricted valve openings and air passages causes excessive heating of the discharge air. Valves which are carbon-clogged may close improperly and permit the discharged compressed air to return to the cylinder. The recompression of the air combined with the wire-drawing as it leaks back through the leaky valves, increases the temperature tremendously and may result in overheating and rupture of weakened parts. Oxidation of the lubricating oil is one of the causes of these trouble-making deposits and can only be avoided by the use of the correctly selected oil.

Excess Oil in Air Compressors

Overfeeding of oil to the cylinders of air compressors invariably causes trouble and should be avoided by the use of an oil of such quality that a small amount will insure a complete and constant film of oil in the cylinders.

The problem is to supply the right kind of oil rather than a large quantity of oil, and to supply it regularly at a minimum rate.

Excess oil in the compressor will decompose in the presence of high temperature and air pressure, and will cause deposits and leaky valves in the same way that an unsuitable oil does.

Results of Efficient Compressor Oiling

The results of the use of the right oil in the air compressor cylinder will be much the same as those attained by the use of the correct oil in the power cylinder. Wear will be lessened, there will be freedom from troublesome carbon deposits, care and attention to the valves and cylinders will be reduced to a minimum, and the cost of maintenance on a high plane of efficiency will be reduced.

General Considerations

The analysis of the conditions existing in the various parts of a Diesel engine requiring lubrication, together with a knowledge of the methods and practices of lubrication, indicates that oils of certain, definite types are needed to fulfil the needs.

The selection and application of oils manufactured to meet these different service requirements and which have been proven reliable in actual use over a period of years furnish the best assurance that an engine will operate with the greatest reliability and economy.

However, each Diesel engine has certain peculiarities of design and features of construction, and minor modifications that have a bearing on the selection of a lubricant, and for this reason it is advisable to seek the advice of the builder of the unit as to its lubrication and the oils most suitable.

Oil Tests

In purchasing lubricants for Diesel engines emphasis is sometimes strongly laid upon certain physical characteristics that are determined by "tests."

A brief explanation of the more common tests of oil will enable the Diesel engine operator to obtain the proper viewpoint on them and just what they do mean to him.

Specific Gravity

Specific gravity of oil is the weight of a volume of oil compared with the weight of an equal volume of water, the comparison being made at 60 deg. F. Specific gravity of oil may be determined in several different ways, the direct reading hydrometer method being the most common.

"Beaumé" is merely an arbitrary scale, in which, in contradiction to the specific gravity reading, the higher the number on the scale, the lighter the liquid. The following examples indicate the difference in the two scales:

DEGREE BEAUME	SPECIFIC GRAVITY
20.0	0.9333
25.0	0.9032
30.0	0.8750

Most oils are lighter than water, and their specific gravity will, therefore, be expressed by a decimal. The test is valuable in determining the type of crude from which the oil was extracted. The gravity or weight of an oil has no effect upon its lubricating qualities.

Flash and Fire Tests

The flash point of the oil is the lowest temperature at which the oil vapors arising from the heated oil will flash. This flash point is indicated in degrees Fahrenheit or Centigrade.

The flash test is made by putting a quantity of oil into a vessel, the temperature of which is raised at a uniform rate. The temperature of the oil in the vessel is noted carefully at intervals just before the test flame is applied.

The fire test is a continuation of the flash test until the vapors arising from the oil will not only "flash," but continue to burn without further application of the flame.

The minimum flash point of the lubricating oils is about 300 deg. F. for the lightest grades. With increasing viscosity the flash point rises and in the residual oils may be as high as 600-700 deg. F. The flash and fire tests of any good grade of lubricating oil are sufficiently high to do the work for which the refiner recommends the product. The refiner is always ready to stand back of his product when it is used for a specific purpose in accordance with his recommendations.

Flash and fire tests are of value in the lighter oils, such as kerosene, none of which are suitable for lubricating purposes.

Pour Test

The pour test signifies the lowest temperature at which the oil will flow. Diesel engines in the marine service will never be exposed to conditions of extremely low temperature and such tests will therefore have no bearing on the selection of oil for this service.

Viscosity

Viscosity is the time in seconds for a given quantity of oil to flow through a standardized orifice at a definite temperature. The Saybolt viscosimeter is used in this country. The readings of the Engler viscosimeters are recorded in degrees, while the Saybolt and Redwood readings are expressed in seconds of time. The Engler and Redwood viscosimeters are used abroad.

Viscosity of an oil is an indication of the body of the oil. It forms a guide to the selection of an oil for a purpose. The selection of an oil that is too heavy or too light to function properly can be avoided by the judicious use of viscosity readings.

In addition, the viscosity test enables the refiner to produce oils of uniform body. This is of value to the purchaser in that the same brand of oil will always have the same characteristics.

Demulsibility

The demulsibility test is a measure of the tendency of the oil to separate from water, indicating its resistance to emulsification. It is useful only in determining the separating qualities of oils especially manufactured to resist emulsification in service.

Oils that are subjected to continuous service in circulation systems where water contamination and impurities of a solid nature are encountered, must have a special quality that resists the forming of an emulsion.

In General

Service is the specification that is of vital moment to the owners of Diesel engines and to the operator who purchases oils for those engines. When an oil performs the work required of it in an efficient manner, with a minimum of wear and cost of upkeep, and when its use insures reliable operation and the economy that goes with it, such an oil is the right lubricant, irrespective of the numerical expressions denoting its characteristics.

The United American Lines have returned their first and second cabin passenger department and the cruise division in New York to 35 Broadway, after reconditioning of the building.

MOMBA, a vessel of 3021 tons gross and 2500 i.hp. for the ADELAIDE S. S. Co., Ltd., of Adelaide, Australia, has been completed. She measures 331 ft. h.p., 46.5 ft. molded breadth and 25.5 ft. molded depth to the upper deck. Her hold capacity is 282,250 cu. ft. (grain) and her deadweight capacity is 5100 tons. The upper deck runs throughout the entire length of the vessel, supported by one row of widely spaced pillars affording large clear spaces in the holds. There are four hatches, served by six 3-ton winches and two 5-ton winches, all of the electric type. Accommodation for the deck officers, engineers, cooks and stewards is provided in the detached superstructure amidships, and the crew is accommodated in the poop. An 8-cylinder B. & W. engine, with 24.8 in. cylinder diameter and 51.88 in. stroke, turning at 95 r.p.m. and developing 2500 i.hp. is installed for a designed ship speed of 11½ knots. This engine is supplied with a supercharging system. The auxiliary generating sets are two of 66 kw. each and one of 33 kw. All engine-room and deck auxiliaries are electrically driven. The vessel was built by Burmeister & Wain at Copenhagen, and the installation of the supercharging system sets the B & W. seal of approval on this development of the German licensees of B. & W.

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Notes on Combustion and Fuel Valves

General Consideration of the Influence of Variation in Air Pressure and Fuel Characteristics

By Chas. H. Bushnell

IN the development of Diesel engines one of the great problems encountered has always been how to raise the mean indicated pressure within the limiting factors of the amount of heat that may safely be passed through the metal surrounding the combustion space and within the temperature at which exhaust valves and cylinder lubrication may be maintained. Improvements in design and metallurgy have done much to overcome heat cracks. Special metals have raised permissible exhaust temperatures as far as valves are concerned. Efficient lubrication with high exhaust temperatures has been and still remains difficult. The limiting factors, however, still exist.

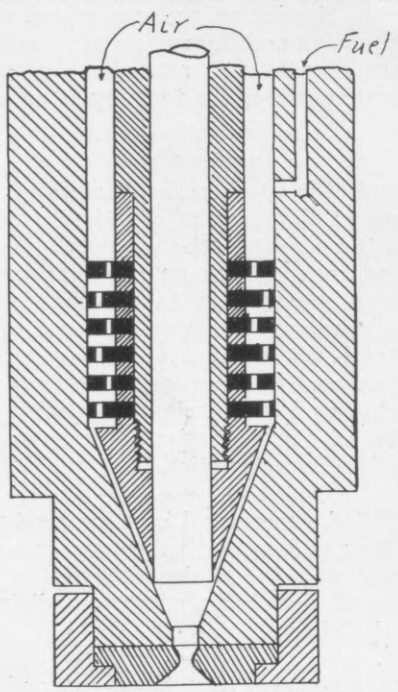

Fig. 1. Baffle type fuel valve

With any given m.i.p. the exhaust temperature may be lowered either by increasing the weight of the air charge or by reducing the time required for the completion of combustion. Without wandering into a maze of thermodynamics it may be stated that the faster the fuel is burned the higher will be the thermal efficiency and the lower will be the exhaust temperature. This would imply combustion at constant volume, but this is mechanically objectionable because of the very high pressures involved. Diesel intended that combustion should be at constant pressure to give the highest practical thermal efficiency.

To produce a flat top indicator diagram it is necessary for combustion to start at a slow rate and to increase rapidly as the combustion space increases. The practical problem is usually to slow down the rate of burning during the first part of the injection period to prevent undue rise in pressure and to increase the rate during the later part to prevent afterburning. This leads to consideration of the means of controlling the process of combustion.

A fuel valve has two functions: first, to admit the fuel to the cylinder at a predetermined point in the cycle and, second, to atomize and distribute the fuel in such a way that it will burn at the desired rate. The timing is simple and is readily checked by mechanical means, but the atomization and control of combustion are more difficult.

Much can be learned from the boiler engineer about burning fuel oil. First, the fuel should be sufficiently atomized to remain suspended in the air until combustion is complete, which means that the fuel should not be allowed to strike any surface whether hot or cold. Second, the atomized fuel should be distributed in such a way that it will be thoroughly mixed with the air. Third, combustion should be completed at a high temperature. Time is an important element in this. The furnace should be of sufficient size to allow complete combustion before the gases strike the tubes. Other things being equal, the finer the atomization the higher the temperature, and the more intimate the mixing with the air the shorter will be the flame and therefore also the time and space required. A Diesel cylinder may be considered as a furnace of very limited space and time.

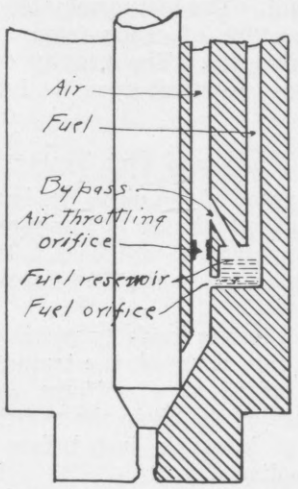

Fig. 2. Differential pressure system fuel valve

As only air injection engines are considered here steam atomizers need be considered only in comparison. They are of two types, the internal and the external mixing. Both are very simple, the essential being a steam jet impinging on a stream of oil. The atomization is accomplished by the high velocity and expansion of the steam, and those which mix the steam and fuel close to the nozzle or tip are the most economical in the use of steam. There should be no interference after the fuel is once atomized, because that will only tend to liquefy it again.

The action of a steam atomizer being continuous there is no difficulty in mixing the fuel and steam, but that is not the case with a Diesel fuel valve, where a measured quantity of fuel is pumped into the valve casing some time previous to the opening of the valve. If there were no mixing device provided ahead of the flame plate the greater part of this fuel would be blown into the cylinder in a slug, ahead of the air. What is usually called an atomizer or pulverizer in a fuel valve is really a mixing device. The atomizing is, or should be, accomplished by the high velocity and expansion of the injection air at the flame plate.

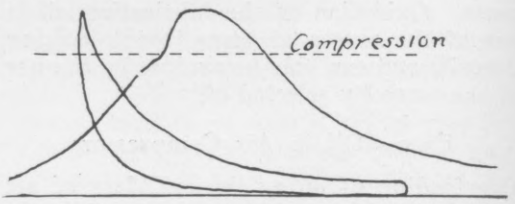

Fig. 3. Improper mixing—too rapid injection

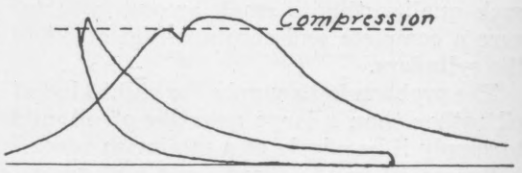

Fig. 4. Same as Fig. 3, but timed later

Fig. 5. Good mixing and good atomisation

Fig. 6. Slow burning due to fuel slug

Two distinct types of mixing devices are in use, though occasionally the two systems are combined. The first of these may be called the baffle system. It consists usually of a number of perforated plates in series as shown in fig. 1. The fuel is deposited on the top plate and is blown through the holes when the valve opens. The fuel clinging to the surfaces will be retarded and may be fairly well mixed with the air. It is apparent that the viscosity of the fuel will have considerable effect on the mixing. Some of the engine builders using this system make provision for changing the number of plates to suit the fuel used. With proper regulation very good results are attained, though there is the inherent characteristic of variable mixing. The proportions of fuel and air will change constantly throughout the injection

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period, the fuel entering the cylinder at a decreasing rate.

The second method of mixing may be called differential pressure system, and its action is shown diagrammatically in fig. 2. Here again the fuel is deposited in the reservoir by the fuel pump some time previous to the time of opening. A small amount of fuel will flow through the fuel orifice by gravity, forming a small ignition charge which may be or may not be beneficial, but the amount is usually so small that it makes little difference. When the needle lifts there will be a drop in pressure as the air passes through the throttling orifice, but the full pressure will remain on the surface of the fuel, and there

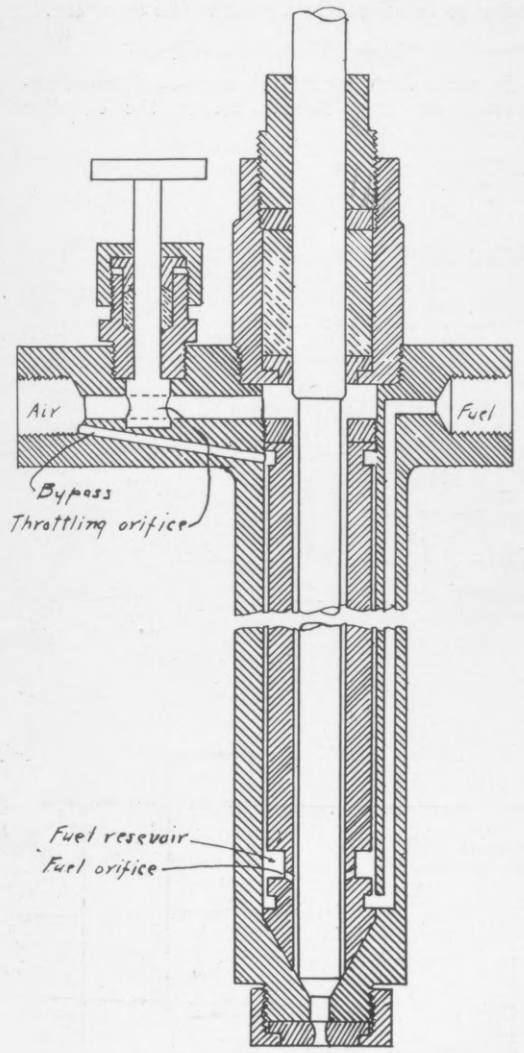

Fig. 7. Adjusting pressure differential

will then be a difference in pressure across the fuel orifice to feed the fuel into the passing air stream. The fuel will be delivered into the cylinder at a fairly constant rate until the reservoir is emptied. This type of mixing device will give very good results if the proportions of the orifices are correct for the viscosity of the fuel used and for the operating conditions.

If the air orifice is too small, thus creating too great a difference in pressure, or if the fuel orifice is too large the fuel will all be delivered during the early part of the injection period and will be followed by air alone until the valve closes. If on the other hand the difference in pressure is insufficient or the fuel orifice is too small only a part of the fuel will be delivered through the fuel orifice during the period of valve opening. The surplus will then accumulate until the reservoir is filled, after which the fuel will be forced by the pump through either the fuel orifice or the by-pass or both. This fuel will tend to collect around the needle and enter the cylinder in a slug ahead of the air.

The indicator card in fig. 3 shows the effect of all of the fuel entering the cylinder during the early part of the injection period. As it is mixed with insufficient air the fuel is not well atomized. The comparatively large particles enter the cylinder with what might be called a "shot-gun effect." These particles quickly leave the cold air with which they enter and mix with the hot air in the cylinder. There is a flash, followed by slow burning. If the time of opening is retarded the effect will be as in fig. 4.

If the proportions of the mixing device are correct, so that fuel delivery is spread over the proper period the indicator card will have a flat top as in fig. 5. When fuel is properly atomized the particles are so small that they have little velocity independent of the air stream in which they are carried. As the fuel is mixed with the cold injection air ignition is somewhat delayed and combustion starts at a slow, but rapidly increasing rate. The card does not show the delayed ignition, for the time of opening was advanced as is necessary with good atomization.

If the fuel is delivered in a slug ahead of the air there will often be no rise in pressure above compression, but burning will continue throughout the power stroke. This will cause either a loss of power or a very high exhaust pressure and temperature. If allowed to continue, the result will be burned exhaust valves, serious liner wear and other troubles. Such a card is shown in fig. 6.

The flame plate is important in atomizing the fuel after it is mixed with the injection air and in distributing the fuel in the cylinder. One or more holes may be used as conditions dictate. Multiple holes usually give better distribution, but may give trouble by stopping up. There should be only such restriction, and therefore drop in pressure ahead of the flame plate, as is required for mixing. The big drop in pressure and high velocity are needed at the flame plate. The area of the holes, together with the overall length of the valve opening, determines the amount of injection air used. Enough should be allowed to pass to atomize the fuel completely with a full load, but more air than this is only a waste of power.

The differential type fuel valves are made in a number of forms, but the principle of operation is the same in all. From the foregoing it will be seen that it is essential that their proportions be correct. It also follows that the proper proportions are determined by the viscosity of the fuel used. Adjustment is possible over a considerable range by altering the size of either the air or the fuel orifices, which usually involves drilling holes of different sizes. This is permissible if the grade of fuel and the operating conditions are fixed, but is not practical where frequent changes are made. Holes are easily enlarged, but not readily reduced in size. Any changes made in this way require considerable time, because it is usually necessary to try out a number of alterations before the desired results are attained. The logical thing to do is to provide some form of valve or other device whereby changes can be made while the engine is in operation, and a little study shows that this is in no way difficult or complicated.

If the pressure differential is to be regulated, some means of changing the effective size of the air throttling orifice is required. This must be at some point between .the by-pass and the fuel orifice Fig. 7 shows diagrammatically one method of doing this, the plug cock being closed more or less, as required.

The problem of regulating the size of

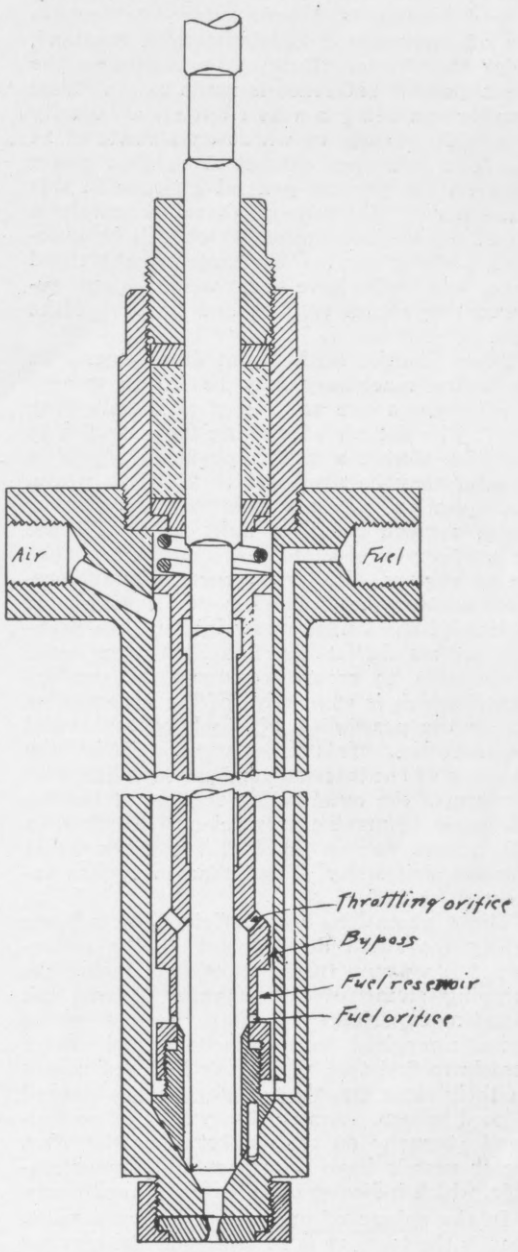

Fig. 8. Adjusting size of fuel orifices

the fuel orifices is a little different, because it must be done at some point close to the bottom of the valve casing and the nozzle effect of these holes retained. It can be done as shown diagrammatically in fig. 8., the tube being made in two parts and joined with a fine thread. As the parts are screwed together the fuel orifices are covered by the lip shown. The bottom member of the tube is held stationary by a dowel while the upper member can be turned by a square cut on the needle. Both of these methods are the subject of patent applications.

The inherent difficulty in burning heavy fuel is due to its slow burning characteristic. Oil burns by vaporizing first, and in general the heavier the fuel the slower it will vaporize. The asphaltum content will not vaporize at all, but will coke.

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Motors Give Ideal Welland Canal Boat

Grain Carrier of 100,000 Bushels Capacity for Canadian Traffic Between Head of Lakes and Montreal

By W. A. Lambert

IN a paper read recently by W. I. Hay and Duncan McArthur before the Institution of Engineers & Shipbuilders in Scotland, under the title of "Bulk cargo vessels on the Great Lakes," reference is made to the "ideal canaller" as being a vessel having a capacity of 100,000 bushels of wheat on a draft of 14 ft. The following extract from that paper sums up the present general attitude in this connection: "Shipowners therefore await a Diesel engine installation which will be absolutely reliable for maneuvering in canals and locks, and will have less weight than reciprocating steam engines and boilers of the same power."

Those familiar with recent developments in oil engine machinery may be led to wonder if shipowners are waiting a needlessly long time. The danger of waiting too long lies in the fact that the useful physical life of a canaller may be averaged at 25 to 30 years. The question presents itself as to whether steam engined canallers built today will not be subject to obsolescence long before that period expires. In Lloyds current annual report occurs the following "a considerable portion of the tonnage now laid up has probably become obsolete and is unlikely ever again to be able to secure remunerative employment," which is suggestive of the necessity of giving the possibility of obsolescence careful consideration. This report also states that "the adoption of the internal combustion engine still constitutes the outstanding feature of the development of marine propulsion." Further, in effect, that during the last ten years world tonnage driven by Diesel machinery has increased tenfold.

These quotations are sufficient to indicate briefly the rapid development of the motorship, but we may further note that during the shipping slump of recent years it was the common experience of those owners whose fleets comprised both steamers and motor vessels to find that while they had lost money on their steamers, their motor vessels showed a good return. Among the welter of second-hand tonnage on the market since the War, motor vessels have been practically unobtainable, which indicates their value in hard times.

In the sphere of operations of ocean going vessels the tonnage is so huge and the services are so diversified, that the trend may be hardly discernible. Good management and good times may possibly tend to soften and defer the full effect of the change, but the same cycle awaits the canaller, and in this sphere the effect cannot but be accentuated by the closely competitive conditions. There is no such variation in the services; the rates and earnings are practically standardized on a capacity basis; the 80,000 bushel and the 60,000 bushel boats cost practically the same to build and to operate; they make the same number of trips in the season and the difference in carrying capacity represents to all intents and purposes the difference in net earnings. In all probability the transition from steam to oil engines will be effected more decisively and more quickly than in the case of the ocean vessel, because the latter vessel has accomplished almost all the experimenting and pioneer work. Once the Diesel engine is adopted for the canaller it will be in a comparatively perfect form and free from the unavoidable delays inherent to the development of Diesel engined ocean tonnage.

The canaller owner who is contemplating new tonnage may well hesitate and consider what the position will be in say fifteen years time, when his vessel may have, in a physical sense, still fifteen years of useful service to render.

The prospect would surely justify an executive in being a little previous rather than a little backward, for he has so much to gain and so little to lose in so doing. For the next few years he can operate the 100,000 bushel vessel on rates which will give a fair return on the 80,000 bushel vessel, while he will afterwards be free from the losing battle of attempting to operate an 80,000 bushel vessel on rates based on a 100,000 bushel vessel.

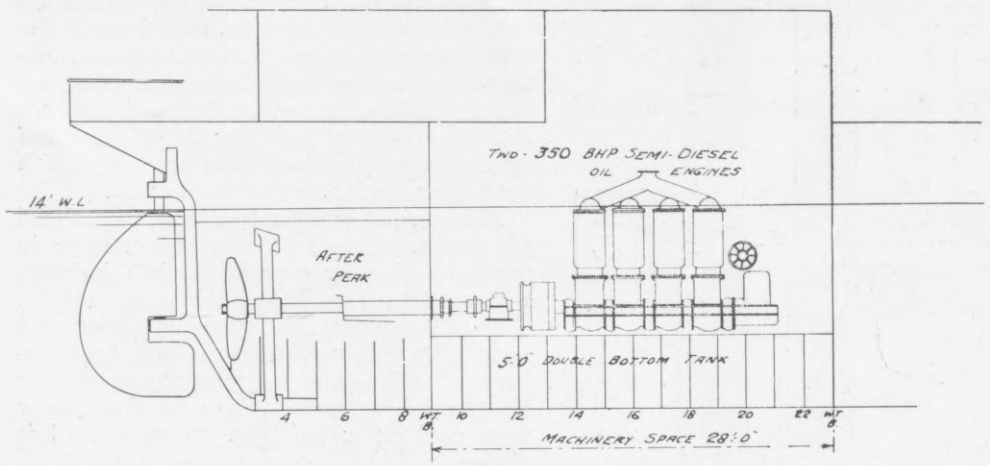
It may be asked is this desired consummation dependent only on the adoption of the oil engine; cannot improvement of hull design be looked to for the same end? In so far as the hull is concerned, progress in design is by no means ended, but while hull design is open to change, in particular due to changes in navigating conditions and to the increasing importance of pulpwood and paper cargoes, there is little prospect of radical decreases in hull weight, which is the vital factor in the problem.

One is led to contemplate why the Diesel engine has been so consistently fought shy of by the canaller owner; why it is that it is practically the only special type of vessel which has shut the door in the face of the oil engine! There are many reasons and it is necessary to briefly recount the chief ones in order to intelligently visualize the situation.

Early Motor Canallers

In early days the Diesel engine was most unfortunately first foisted on to the canaller when in its experimental stage. The CALGARY, the TOILER, the FORDONIAN and the TYNEMOUNT were installed with Diesel engines a decade ago. They were seriously handicapped in being given too little power. The CALGARY, for instance, only had 520 hp. and it was not the fault of the type of motive power that this vessel could not go up the currents unaided when loaded to more than 12 ft. 6 in. draft. They would have been failures if they had been steamers and given the same power.

The TYNEMOUNT had Diesel-electric drive and was converted to steam and re-named PORT DALHOUSIE before coming to Canada. The original oil engines, though not permitted to remain in these hulls, did not give bad service



Comparative elevations of surface-ignition oil engines and steam in Welland Canal boats

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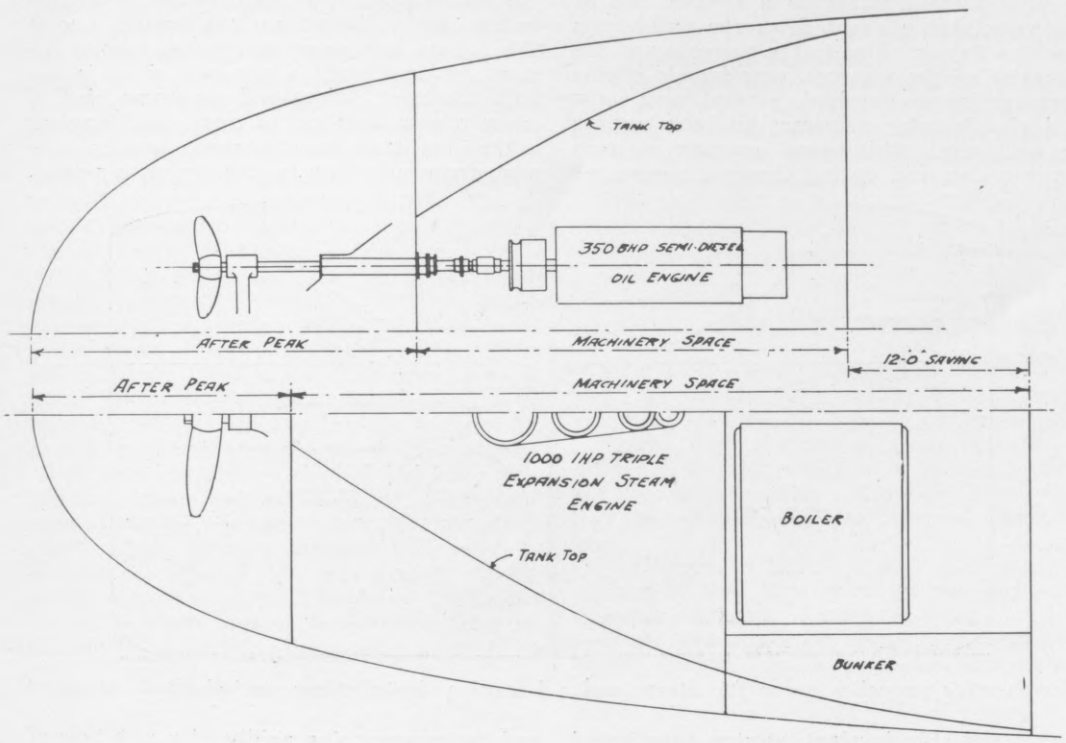
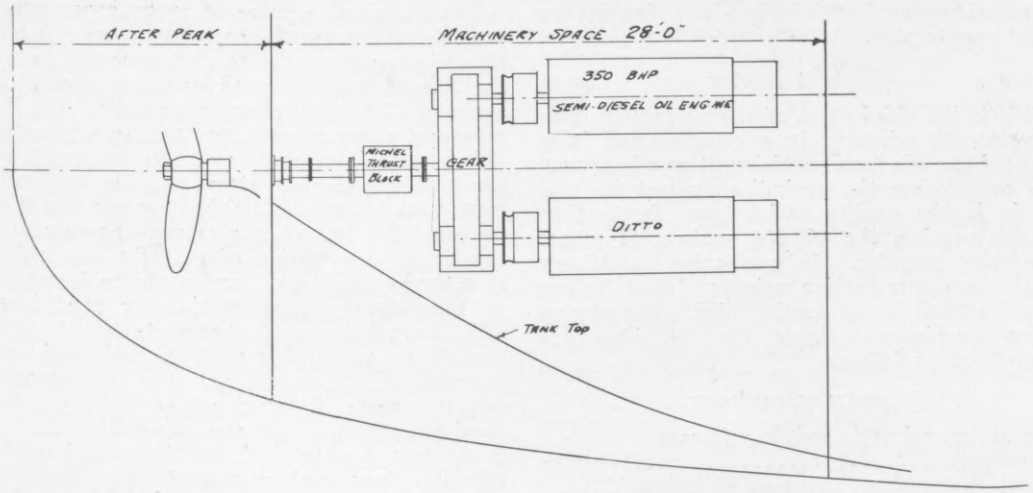
considering that they were made at a time when hardly two engines were built alike, due, as before mentioned, to this type of machinery being then in its swaddling clothes. Naturally under these conditions spares were difficult to obtain and were often required. A special type of engineer was necessary—a type not easy to obtain. It is not surprising that comparatively small troubles caused serious and costly delays, and the experience has never been forgotten or forgiven. The records of those early vessels are largely responsible for putting back the clock so far as the development of oil-engined canallers in the Montreal trade is concerned. Recently the motor canallers STEELVENDOR and STEELMOTOR have been built for the U. S. Steel Corporation and have been noteworthy for trouble-free operation; it is understood that two similar vessels





Comparative plans of machinery layout with surface-ignition oil engines and steam respectively

are under construction. The FORDONIAN, the TWIN PORTS and TWIN CITIES are now examples of Diesel-electric canallers which have functioned satisfactorily. In the case of the Steel Corporation's vessels no attempt was made to obtain record capacities, their trade being non-competitive, while the Diesel-electric vessels though very attractive in some ways are perhaps too complicated and expensive to appeal to the average owner.

Possibly, the principal reason why the steamer is still overwhelmingly predominant in Lake and canal transportation is that the advantages of the oil engine for this class of tonnage, though of extreme potency, have not been convincingly demonstrated to the owner.

Nevertheless, competition is a hard master, and the balance sheet usually has the last word. While times are good and rates are high the incentive for an economy which is wrapped up in doubt is not a driving force and the tendency is to let the other fellow do the experimenting. Last year, however, was none too good so far as operating conditions in the Welland Canal trade are concerned; in some cases the shoe of reduced profits has pinched, and perhaps an analysis of the economic possibilities and of the various possible alternatives of the oil-engined canaller such as the Diesel, the Diesel-electric drive, and the surface-ignition engine will at this time be more interesting.

It should be realized at the outset that every unit of weight which can be saved means that much weight added to the cargo and is translated practically 100 per cent into increased net earnings, for whether a vessel carries 2,300 tons or 2,400 tons makes no practical difference to operating expenses, and if of this 2,300 tons, 300 tons represents net profits, the increase of net profits in the 2,400 ton ship is 100 tons, a gain of 25 per cent. This is perhaps somewhat elementary, but its significance is apt to be lost sight of because there is perhaps no other vessel operation in which such a condition applies to an equal degree.

The full Diesel's good points are reliability, propelling efficiency and economy of operation; its weak features are weight, cost and space, though the two-cycle and double-acting types are better than the four-cycle and single-acting. In other respects it is fairly neutral. The Diesel-electric arrangement is strong on reliability, maneuvering ability and propelling efficiency; it is not so good as to simplicity, weight and cost. The surface ignition engine is excellent in reliability, weight, simplicity, cost and space, but is objectionable on the score of propelling efficiency; it also has one or two other drawbacks which will be referred to later.

The Surface-Ignition Engine

Careful consideration of these qualities would seem to result in a preference for the surface-ignition type of installation, and this confirms the judgment of Mr. McGovern of the Furness Shipbuilding Co., who has recently stated that given surface-ignition engines he can build a 100,000 bushel canaller. This type of engine is not usually regarded with particular favor in such high power as is demanded for a Welland Canaller; in fact its present power limit per unit, as actually manufactured, is 600 b.hp., although a 700 b.hp. model is offered by one maker at least. The implied preference is simply due to its good points being of emphasized value in a vessel of the type and for the trade under discussion.

It is essential to the determination of the ideal canaller that the power required be decided upon. Here we have ample data to assist a preference. but nevertheless there is a considerable difference of opinion. Some will say 700 hp. is sufficient while others think nothing less than 1000 hp. will suffice.

If careful study be given to actual performances, it will be found that so long as the voyages are confined to the Welland Canal trade, say Fort Colborne to Montreal, the lower limit is probably satisfactory, and certain it is that the lower-powered vessels in this trade make as many trips in the season as the higher-powered. If, however, the vessel is required to be generally adapted for service to the head of the Lakes, and down to the Gulf for pulpwood, with a possibility of service coastwise in the Winter months, then 1000 hp. is none too much.

Assume, for the purposes of this analysis, that as 100,000 bushels capacity is the ideal we are driving for, it is the vessel confined to the Welland Canal trade which is in question, but before tabulating the definite economies of the surface-ignition engine as against the steam engined vessel, let us give a little study to the alleged disadvantages of this engine, which are not included in the factors above mentioned. The actual limit of the surface-ignition engine as manufactured and in successful service today is 600 hp., and there are, we will say, three firms producing up to about this power. It is hardly within our scope to attempt to discuss why this limit exists, but it obviously renders twin screw propulsion necessary. There have been, and are, a number of twin screw canallers in operation and the consensus of opinion seems to be decidedly in favor of single screw propulsion, because with twin screws there has been a tendency to damage propellers against the sides of the canals. Some credit should be given, however, to the better steering control which twin screws, properly placed, allow. Research work has recently been carried out in the Suez Canal, the results of which have been incorporated in a most interesting paper read before the Institution of Naval Architects, London (1924 Proceedings), under the title "Steering of Ships in Shallow Water and Canals." This paper is well worth the study of all interested in canal vessels and there are recommendations of particular interest to this phase of the subject. The quotations are as follow:

"The slip stream plays a far greater part in shoal waters than in deep, and for good steer-

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ing, propellers should be placed sufficiently close together to ensure that the stream lines between the two races are not adversely affected by them.

"In twin screw ships the rudder should swing into the screw race at a fairly small angle. Ships in which this angle is over 15 deg. have not good reputations in the Canal (i.e. Suez), but a smaller angle than this is desirable."

In other words, the closer the two screws are together the better the effective steering qualities of the rudder. This is particularly useful when the vessel has little or no way on her, and is, of course, very helpful to placing the propellers where they are less likely to receive damage from the canal banks. A small angle has a further double advantage—the smaller this angle the sooner can effective helm be put on the ship, and when the ship has begun to answer the helm, it can be taken off quickly.

"If the ship through being near a bank develops a bad sheer across the Canal, and the helm appears to be insufficient to stop it, the better maneuver is to stop the engine on the bank side rather than to go ahead on the other engine. It is wrong to go astern on the engine on the bank side, because this not only stops the sheer but takes way off the ship, and produces one in the opposite direction, which again requires correction and consequently tends to create a series of oscillations from one bank to the other. If the former procedure is adopted, any opposite sheer developed is more easily controllable by the rudder.

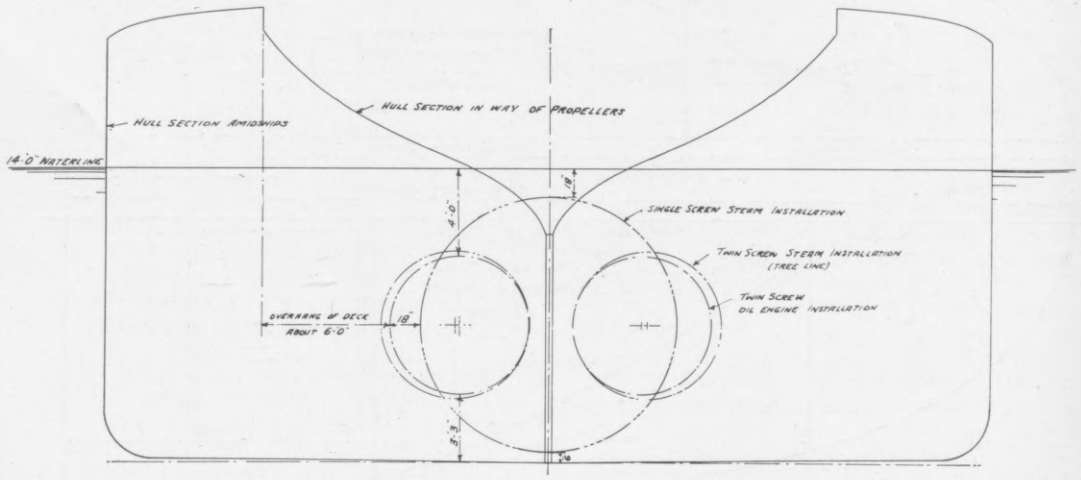
"With twin screws the turning movement which can be produced by manipulation of the engines is very large, altogether swamping any helm effect."

These quotations at least serve to indicate that the twin screw vessel allows very high steering qualities, which should go far to offset the danger of propeller damage. But is propeller damage likely to be such a bogey after all? The most noteworthy example of twin screw canallers are the ten sister vessels owned by the Tree Line Navigation Co., which, however, were not designed for the Welland Canal trade. The management advise that these ten vessels have only sustained twelve propeller damages during the past season of navigation, which is certainly not excessive, while it should be noted such damage does not usually incapacitate a vessel and is of a nature which can be made good with the minimum of interruption to service. One calls to mind in this connection the "Rapids" boats of the Canada Steamship Lines, which frequently sustain propeller damage in the rapids but with little or no interruption to service. Possibly no other kind of damage causes so little service disorganization.

Propellers

If reference is made to the diagram showing the relative propeller areas of the single screw steam canaller, the twin screw steam canaller, as exemplified by the Tree Line vessels, and the twin screw canaller with surface ignition engines, it will be seen that the propellers of the latter, while projecting transversely beyond the limit of the single screw, are not quite so obstructive as those of the Tree Line vessels. The excess projection over the single screw steamer is, however, so little that the disadvantage from the point of view of canal side damage is relatively slight. But notice the difference in a vertical direction, which is all in favor of the surface-ignition installation! The propeller tips are much further above the base line, thus eliminating altogether possible damage from the canal bottom, and the upper sweep is much further below the water line, so that whether the vessel is light or loaded the propellers are always, even in rough water, well immersed and operating at highest efficiency. Twin screws therefore possess factors of value as well as drawbacks, and it is by no means assured that this feature should be allowed to weigh against the surface-ignition installation.

Of course steam is ideal in respect of reliability and is a proved quantity. It is such an important quality that the surface-ignition unit, more or less an unknown quantity, naturally raises apprehension. However, it has been made, and has been in service in all parts of the world, for over 20 years, and its reliability is thoroughly well-established in other trades. The automobile ferry "Jacques Cartier" at Lachine, Que., is a case in point. This vessel, equipped with two engines of well known surface-ignition type, operates across the St. Lawrence River at the head of the Lachine Rapids. The currents are very strong and on the South side the vessel has to go through a whirlpool. If the machinery were unreliable there would be a serious risk of the vessel being swept down the well-known Lachine Rapids. Due to the currents and the situation of the wharves, considerable engine maneuvering is involved, several reversings and aheads being necessary on both engines on each trip. This vessel operates eighteen hours a day, and during the past navigating season the only involuntary stop experienced on either engine was due to a piece of waste (probably placed with intent) stopping up the fuel supply pipe.



Comparative propeller areas for steam and oil engine installations in Welland canallers

Weight Factor

This is the chief asset of the surface-ignition engine for adoption in a canaller and it is indeed the one factor which will go a long way to overcoming the prejudice against its use. This is the quality which goes farthest to make possible the 100,000 bushels of wheat capacity canaller. In comparing machinery weights, the respective weights of fuel for one week at full power are included. The respective machinery weights for 700 i.hp. are tabulated as follows:

STEAM MACHINERY

Total machinery weight (steam raised)	150 tons
Coal in bunkers 7 days at 15 tons= 2 lb. per hp.-hr., American coal	105 tons
Total weight	255 tons

SURFACE-IGNITION ENGINES

Two engines of 350 b.hp. including shafting, sterntubes, propellers, auxiliary compressor and dynamo set, air bottles, control gear, etc.	65 tons
Donkey boiler with water	5 tons
Oil fuel, 7 days at 3.45 tons = 0.46 lb. per hp.-hr.	25 tons
Total weight	95 tons

Saving in favor of the surface-ignition installation—160 tons.

This saving would be correspondingly greater for a 1000 hp. installation in the case of the canaller of less confined service.

The first cost of surface-ignition machinery is not excessive, probably not more than steam machinery, if installation, auxiliaries, seatings, trial expenses, etc., are included in both cases.

The twin screw installation may tend to increase cost slightly but the increase should not be sufficient to affect the situation.

In the case of a shipbuilder who neither carries an engineering establishment nor makes his own steam machinery, oil engines may easily decrease his costs, for the installation work is considerably simpler and less costly than for a steam set.

If there is one quality above others which the average canaller owner is distrustful of in an oil-engined installation, it is maneuvering ability. Machinery difficult or slow to handle is a source of worry to the crew and of anxiety to the owner. Occasionally a canaller due to this failure, and sometimes to the human element, breaks through a lock gate, which is perhaps the most serious and expensive kind of casualty possible short of total loss. Engines in the canal trade have to maneuver very much more frequently than in ocean or river service, and the maneuvering ability of a new type of engine is a very vital question.

The increased volume of cargo space made possible by the use of oil engines is best demonstrated diagrammatically, and reference to the sketches show a decreased length of machinery space of 12 ft. over steam machinery. The increase of cargo space is not particularly valuable in so far as a wheat cargo is concerned, as the average full-sized steam canaller has sufficient hold volume for 100,000 bushels, but it is of value for lighter grains such as oats and for the transportation of pulpwood, in which case the height of deck load might be decreased with resultant improved stability conditions. The increased space represents about 6500 bushels or, presuming a 12 ft. deck load and stowage of 128 cu. ft. per cord, an increase of 110 cords. It must not be lost sight of, however, that all increases are subject finally to decreased weight of machinery and corresponding increased weight of cargo possible. It is worth noting that the fuel is very easily disposed of, the quantity being comparatively small, stowable in comparatively inaccessible places unfit for cargo, such as double bottoms, and is handled by gravity.

Propelling Efficiency

The propeller speed of the surface-ignition unit is rather higher than the average engineer approves of, but it has some compensating advantages which should not be lost sight of. For instance, fast revolutions mean small propellers, and it is common knowledge that a propeller to be efficient should be well immersed, and a good rule is to immerse the tip by a distance equal to the radius of the wheel. A propeller operating in a depth of water not

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much greater than its diameter is not efficient, the slip increasing considerably in shallow water; so that while a large slow-moving propeller well immersed is excellent in deep water, and a small fast-running propeller is comparatively inefficient under these conditions, the reverse is the case in shallow water, which is the condition which applies when operating in the canals. There is, however, no question but that the small propellers of the surface-ignition installation will not provide the quick backing power that is such an attractive quality for canal work.

Of recent years the combination of fast running oil engines with slow moving propellers has been effected by the introduction of gearing, mechanical, hydraulic and electric. Such systems also permit the coupling of two engines on to one propeller shaft, and, in the case of electric transmission, permit of pilot house control. The introduction of gearing or other form of indirect transmission, however, means increased weight and greater cost, two factors—undesirable factors—while gearing is not an attractive proposal to most engineers. Therefore, to avoid this complication and yet be on the safe side, concede a loss of efficiency in small propellers of say 15 per cent, though such a loss really remains to be proved. Now the oil engine is almost always rated on a brake horse power basis, which is the horse power developed on the shaft, while the steam engine is always rated on an indicated horse power basis, which is the power indicated in the cylinders. The actual difference is about 15 per cent, the 100 b.hp. oil engine being on an equality with a 115 i.hp. steam engine. If, therefore, we take performance of 700 b.hp. oil engines and assume it to be the same as a 700 i.hp. steam engine, we shall thereby take care of our 15 per cent loss of propeller efficiency which we have assumed with surface-ignition machinery. We will neglect the superior operation of the oil engine due to not having to clean fires or to suffering from inefficient firing, as in a steam boiler installation.

Operating Expenses

Comparative operating charges are affected in the main by cost of fuel, although the oil engine installation also permits a smaller machinery personnel. This latter can, however, be disregarded, as, to start with perhaps, higher wages could with advantage be allowed to the oil engine crew. It may be well worth while to take such means to overcome the inevitable initial prejudice of the steam engineer.

The fuel costs of a steam canaller are well established, but for a motor canaller with surface-ignition engines, they must be estimated. Nevertheless, it is possible to obtain a close and reliable one. Included in the paper previously referred to, given by Messrs. Hay & McArthur, is a tabular statement which shows that the fleet referred to operated an average of 200 days per season on an average fuel expenditure of 12½ net tons of coal per day or a total of about 2500 net tons. Assuming an average cost of $6 per ton, we have a season's fuel cost of $15,000, but the average power used by the vessels referred to is probably nearer 850 hp. than 700 hp. The fuel bill for comparison purposes should, therefore, be reduced to

$$\frac{700}{850} \times \$15{,}000 = \$12{,}350.$$

The same statement further gives the information which will permit a fairly close estimate to be made of the fuel consumption of a surface-ignition engined canaller. According to this authority the following averages governing operation apply:—

Canalling	34	days
Open running	74	"
Loading and discharging	70	"
Accidents and repairs	10	"
Miscellaneous	12	"
	200	days

The full power consumption per hour is 42 gal., and the following estimated consumptions will, therefore, apply:—

	Gal.
Canalling, 34 days @ half fuel consumption	17,136
Open running, 74 days @ ⅞'s fuel consumption	65,712
Loading and discharging, 70 days @ 150 gal. per day	10,500
Accidents and repairs, 10 days @ 75 gal. per day	750
Miscellaneous, 12 days @ ½ fuel consumption	6,048
	100,146
100,146 gal. @ 10c	$10,015

$12,350 — $10,015 = saving if coal is $6 per ton = $2335

or if coal can be bought for say $5 per ton, the fuel expense will be equal.

We can now apply to our text the data we have arrived at. The ideal sought being cargo carrying capacity, it will be conceded that the vessels of the Eastern Steamship Company are the present largest carriers.

They are said to be capable of carrying 92,000 bushels of wheat on 14 ft. draft in fresh water when carrying 60 tons of fuel. The equivalent weight of fuel in an oil-engined vessel would be 10½ tons. The respective machinery weights with equal radius are:—

	Eastern S.S. Co. Boats	Surface-Ignition Engined Canaller
Machinery weight	196 tons	74 tons
Fuel	60 tons	10½ tons
Total	256 tons	84½ tons

Difference in favor of surface ignition oil engine = 171½ tons = additional cargo carrying capacity = 384,000 lb. = 6400 bushels wheat. Total capacity, therefore, is (92,000 + 6400) bushels = 98,400 bushels.

We have not arrived at quite 100,000 bushels on 14 ft. draft, but this capacity is possible with an added draft of only 2 in. or possibly the few necessary tons may be obtained by either filling out the form still more and cutting hull weights slightly. The sum and substance of this analysis is that by using surface ignition engines the 100,000 bushels canaller is brought measurably within nearer reach, and with reduced operating costs.

Messroom Maxims and Fables

THE oil engine automatically takes care of fuel economy, making it only necessary that the engineer take care of the engine.

Valves never happen to burn up. When they get in that condition it is best to find the root of the trouble. To replace them with new ones only means that they will burn up also.

The success or failure of an engine depends upon how well it works. As for you—Oh, laugh it off, boys. I can't be trite.

If the boss thinks Dr. Diesel discovered perpetual motion, just do what you can to set him right.

The difference between a good engine and a poor one is sometimes just a difference in the treatment received.

Never heard of a successful repair being made to a pressure gauge by tapping it with a screw driver handle.

Have heard of breaking a glass that way. Still the compressor seemed to pump along at the same rate.

Lack of industry is more often the reason for failing to work up to a high standard than lack of opportunity.

In other words, it's much easier to pass a ship that is drifting than one that is running you a race, even if she is slow.

The man who neither sees, hears nor thinks had best not speak.

Some engineers, although knowing that to work in a hot part of the engine room makes them uncomfortably warm, cannot seem to apply the same line of reasoning to an electric motor, and, when it gets uncomfortably warm, think there is something wrong.

Clean air to breathe, pure water to drink and good wholesome food are to the man what clean air to breathe, clean water for cooling and clean oils are to the motor.

And like the man who does not work, the engine lying idle deteriorates more rapidly.

To neglect the air compressor and fuel pumps on the oil engine is like neglecting one's lungs and heart. A little common sense will keep them in condition. Once they are in bad shape, special treatment will be needed, and even then the whole works may stop before an adjustment can be made.

We have often heard it remarked that a leaking joint may take itself up and remain tight. It may. On the other hand, it may not, but experience teaches us that to take it down and make it up right eliminates the doubt.

Send us some flowers for Johnny M. Lessor.

Who poured kerosene in the main air-compressor.

The careless engineer can surely sow a hard row for the very best designer to hoe. Now you tell one about the sort of a row some designers can sow for the engineer.

Granting that an oil engine can be started on steam, what's the use? Where oil engines are coming in, steam is going out.

With due apology to Rudyard Kipling and full credit to an unknown poet we present:

The Vampire Sea

A fool there was and he went to sea
Even as you and I,
And he chose a life of misery,
Though the poets call it brave and free,
But a fool he was and a fool he'll be,
For only a fool would follow the sea,
Even as you and I.

A fool there was and his life he spent,
Even as you and I,
In a vile hole that was never meant
For a thing that God his image lent;
But we go to sea by our own consent—
For only a fool knows a fool's content—
Even as you and I.

Oh, the love we lost and the joy we lost
And the light of the home we planned
Were won by the man who stayed ashore,
Who had brains and sense and a whole lot more
Of the things we don't understand.

For the world rejects us derelicts
When we turn again to the land,
With our withered minds, as mental wrecks,
With a cold disdainful hand.

All he has left is his foolish hide,
That is carefully fleeced and flung aside,
To sink or swim on the deep sea tide,
Where some of him lived but most of him died,
Even as you and I.

Drifting from fo'c's'le to fo'c's'le and engine room desk to chart room, this fool thing has made a hit with many a seafarer, and yet I wager that not many seafarers would care to sail with the unknown author, if he spouted that sort of sentiment all the time. A. B. N.

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Sketches and Working of Oil Engines*

Typical Starting Valves and Control Methods. Considerations for Safe and Positive Operation

WITH the exception of a relatively few electrically maneuvered submarine motors, all oil engines are started by compressed air and reversed by the same agency.

As the use of compressed air for starting purposes is only temporary, it is at once obvious that the valve for admitting the air to the cylinder must be capable of being thrown in or out of operation at will.

Practically all starting valves, whether opening directly into the cylinders or into a pipe leading to check valves in the cylinder heads, are so arranged that they may be either pneumatically or mechanically thrown into engagement with the proper cams. Sometimes a special lever is provided for this purpose, sometimes it is the fuel control lever, or "throttle," which when moved into a certain part of its travel, causes the air-starting cam rollers to engage while at that period the fuel may or may not be shut off. In these designs, there is practically zero travel between the "starting zone" of the lever travel and the "fuel zone" in order that as little time as possible may be lost between the moment when compressed air ceases to be supplied and fuel begins to be injected.

Although practiced in many cases, the admission of starting air and fuel are not allowed to overlap by some designers because they fear that explosions might result. In the majority of designs the engine is simply speeded up by compressed air and is allowed to "coast" from the instant at which the last admission of starting air takes place until the first ignition has occurred.

In those engines provided with a special compressed air starting lever, the latter is sometimes connected to the fuel pump in such a way as to prevent it from delivering up to the moment where the starting cam rollers have been completely cleared off their cams. As soon as that happens the fuel pump is released and begins to pump at a rate corresponding to whatever degree of "throttle" opening may have been set by the engineer.

A certain number of Diesel engineers also provide means for throwing the fuel valve out of gear during the starting period, even though the supply of fuel coming from the pump is shut off at that time anyway. One of the reasons for doing this is to economize injection air. Although the amount entering the cylinder through the relatively fine injection orifice is not sufficient to have any great effect on the starting of the engine, it may seriously pull down the pressure in the injection air bottle at a time when the compressor is running slowly and is fully taxed with the task of pumping air for maneuvering. Another reason for preventing the fuel valve from opening during the starting period is that fuel from a previous run may still be present in the atomizer and may cause an ignition at the moment when the starting valve is open. In such cases the resulting flame has been known to strike back into the starting air line, past the open starting valve, firing lubricating oil vapors therein contained, and giving rise to destructive explosions. However, the chances that this may happen are considered slight by a number of prominent builders and they accordingly avoid the mechanical complication involved in providing a fuel valve cut-out. In the latter engines the fuel valve therefore opens normally even during the starting period and the injection air admitted simply adds a little to the starting impulse provided by the normal charge of starting air.

Means have sometimes been provided for shutting off not only the fuel supply from the pump, but also the supply of injection air with which the atomizers are supplied. One objection to this practice is considered to be that it allows the compression pressure in the working cylinder to back up into the atomizer. Should a charge of fuel happen to have remained there from a previous run, it may be ignited by the highly heated air and fuse the atomizer parts because of their delicacy and on account of the concentration of the flame in such a way as to produce blow-torch action. Atomizers to which this has happened look very much like the one illustrated in Fig. 136 (MOTORSHIP, April, 1926, page 302, Fig. 135). At the same time there is again the element of danger due to the presence of oil vapor in the injection air line, along which an explosion may propagate itself.

By far the simplest method of starting a single-cylinder engine consists in using an inward-opening poppet valve connected to the compressed air supply and actuated by a hand lever and a spring. After barring the engine a little past the firing dead center the operator jerks the valve open by hand and watches a white mark on the flywheel rim as it begins to revolve. The next time the mark passes the firing dead center he jerks the valve open again, repeating this procedure until his engine has attained what he considers adequate speed. He then relinquishes the starting valve lever and throws the fuel injecting gear into operation, which functions while the engine continues to revolve because of the momentum in the flywheel. After one or two revolutions made in this manner the engine begins to fire. Should it die down before an ignition takes place, the operator again throws the fuel gear out and again pulls the starting valve lever, generally in time to prevent the engine from reaching a complete standstill.

This procedure, of course, cannot be used for marine engines, the maneuvering of which must promptly obey signals from the bridge. It is essential, also, that the engine be capable of starting in any position. That in itself would require the use of starting valves cam-operated during the starting period and makes it necessary that at least one valve is ready to open whenever the starting gear is thrown in. In the case of a 6-cylinder 4-cycle engine, for instance, three strokes during which exhaust and inlet valves are simultaneously shut are available per revolution. Hence, if at least one starting valve must be ready at all times, all six of them must have a duration of opening corresponding to a minimum of 120 deg. of crank travel. In most cases such valves generally open 5 deg. past the dead center and remain so until 130 deg. after. This provides 5 deg. of overlap at each end. Let it be assumed, say, that No. 1 cylinder stops 2 deg. past the top dead center on what would normally be the firing stroke. If No. 5 is the next one in the firing order, its crank will be 122 deg. down the stroke and its starting valve will remain open for 8 deg. more. That is sufficient to make No. 1 open, which remains so long enough to give the engine a good impulse forward and to get the valves on the remaining cylinders working in their due turn.

A 130 deg. opening is, of course, considerably more than would be desirable from the point of view of air economy, but as explained above, there is no help for it. Six-cylinder 2-cycle engines are considerably better off in this respect, requiring a minimum of only 60 deg. of starting valve opening. This would, of course, be the same for a 6-cylinder 4-cycle double-acting engine and half that amount for a 2-cycle machine of the same type. Three-cylinder 2-cycle engines are heavy consumers of starting air because the relatively early opening of the exhaust ports requires the use of long starting valve openings and they are rarely, if ever, used for marine work. The earliest ocean-going marine engine ever built was a 4-cylinder machine and was started by converting it temporarily to 2-cycle operation. A shift of the camshaft deprived the inlet air valve of all operation while two-lobed cams were thrust under the exhaust and starting cam rollers. As soon as the engine attained speed on air the camshaft was shifted back while the fuel valve was cut in and normal 4-cycle operation restored.

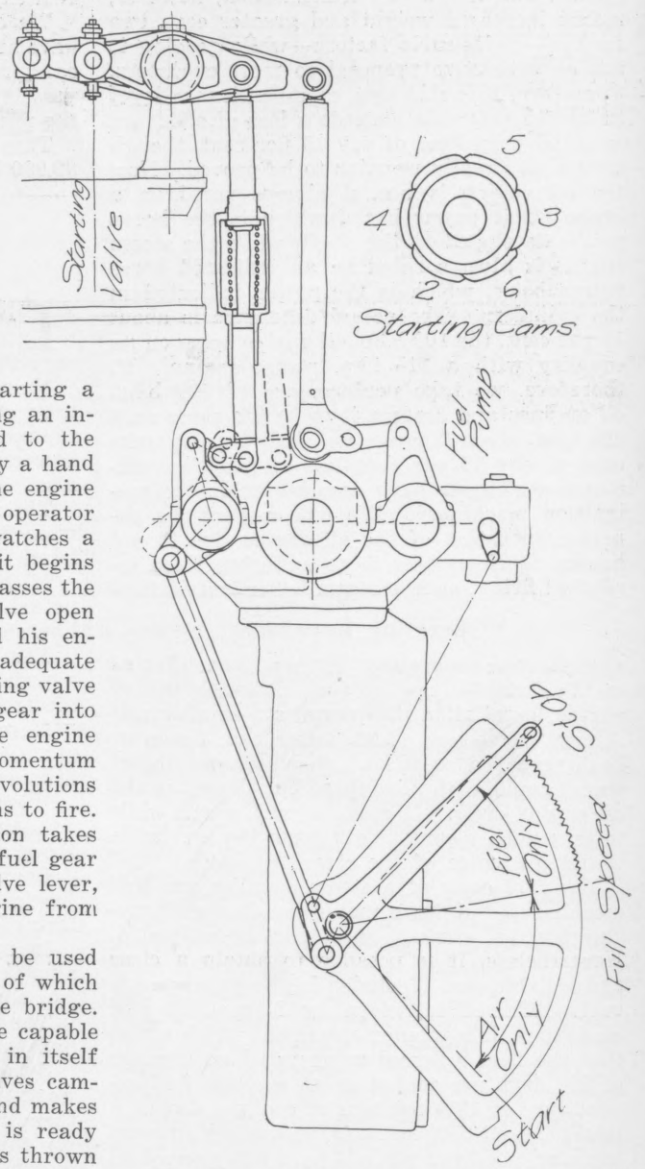

Fig. 139. *Starting valve manually engaged*

In modern designs diverse methods are employed for getting the starting valves in and out of gear, practically all of them depending on engaging or disengaging the starting valve

*Summary of a Course of Instruction at the Polytechnic Institute of Brooklyn, N. Y., by Julius Kuttner, B.Sc., Licensed Chief Engineer, Editor of OIL ENGINE POWER and Associate Editor of MOTORSHIP. This is the fourteenth chapter, the first one having appeared in the January, 1925, issue.

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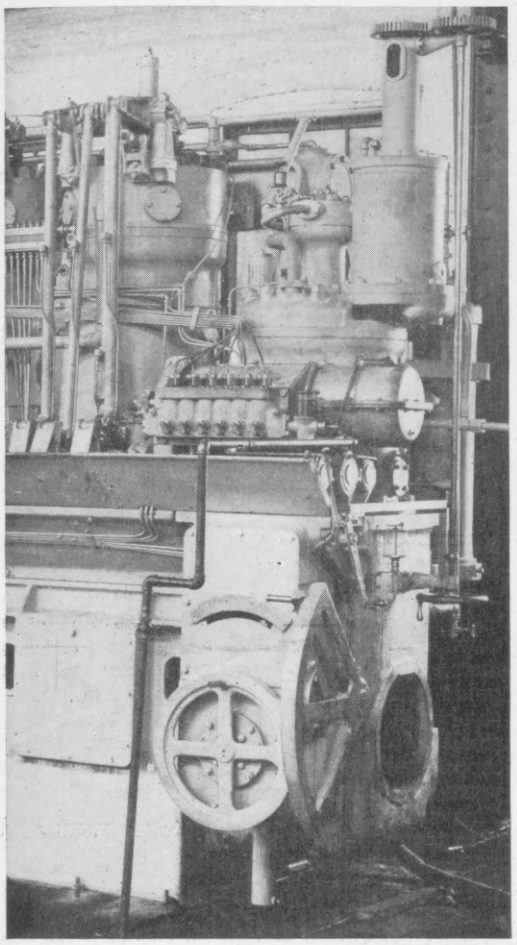

Fig. 140. *Starting lever working over sector*

roller and its cam. In the mechanical types (Fig. 139) it is common to find that the starting cam roller is mounted in the end of a fairly long push rod leading up to the starting valve. A guide link must, of course, be provided for holding the roller to a definite travel above the cam centerline; it is a simple matter then to put the stationary end of the guide under manual control. While the engine is at rest or running on fuel the roller is held entirely clear of the cam, and, for starting, the guide link is simply pushed over until it places the roller in the proper position. As previously outlined, the arc-length of the starting cams of a multi-cylinder marine engine is such that of all the starting cam rollers swung over at least one of them will find a cam in its way. In rolling up on the latter it lifts the starting valve and allows it to seat again in the normal course of the engine's operation on air.

The objection may be raised that if normal cylinder compression exceeds 450 lb. per sq. in. the starting air pressure must always be greater than this if air is to flow into rather than out from the cylinder. In the early days of Diesel engine building it was therefore common to find that starting air receivers charged at 1200 lb. per sq. in. were used both at sea and on land. To withstand such pressures seamless drawn steel bottles had to be used; they were expensive and had operating drawbacks such as being inaccessible from inside and subject to interior corrosion difficult to observe and prevent.

In order to use starting air of a pressure that will permit safe storage in riveted steel tanks, the starting gear on the engine cylinders is generally modified by the insertion of a spring or pneumatic resilient member somewhere in the mechanical drive of the valve (Fig. 139). This has the double effect of converting it into a check and a safety valve. So long as the pressure in the cylinder is below that of the starting air the valve simply remains shut and opens only when the starting air pressure acting on the head of the poppet valve and assisted by the force of the spring compressed by cam action, overcomes the cylinder pressure. Should there be an explosion or other unexpected pressure rise in the cylinder the starting valve shuts automatically. This action is depended upon to shut off the starting air supply when no provision is made to cut out fuel injection during the starting period; at the first pressure rise caused by ignition the valve is slammed shut of its own accord. Rigidly-actuated valves more or less compel fuel to be shut off during the starting period because in that case an ignition might start a dangerous oil-vapor explosion wave traveling along the starting air line and into the tanks.

On smaller engines a certain amount of valve-gear complication is sometimes avoided by grouping all the starting valves for the various cylinders in a chest located in some place convenient for driving (Fig. 141). As all the cams and controls may also be concentrated there, considerable simplifications can be effected. When that is done it is essential that a check valve in each starting air line be fitted in or close to the cylinder head (Fig. 142), otherwise the cylinder clearance would be increased by the volume of the pipe. Each timed impulse of starting air coming from the cam-controlled valves travels along the pipe and lifts the check in the cylinder head as soon as the cylinder pressure permits it. As before, an overpressure in the cylinder arising from any cause simply makes the check valve shut. Such an arrangement, of course, is too wasteful of starting air to permit its general employment on large engines, the size of the starting air tanks and maneuvering compressors of which is never a negligible matter. For smaller engines it is however quite frequently used.

Engaging and disengaging the valves of such an arrangement with their cams is sometimes done by manual control and sometimes by the starting air pressure itself. In the former case a fork or hook holds the stem end of the poppet valve entirely clear of the cam travel so long as the starting air is shut off. A movement of the starting handle then has the double effect of first letting the poppet valve seat or touch its cam and immediately afterwards opening the starting air supply by means of a balanced master valve admitting air to the common chest in which the individual poppets are seated. The springs on the poppets urge them toward the cams and toward the seats, being compressed when the cams act or when

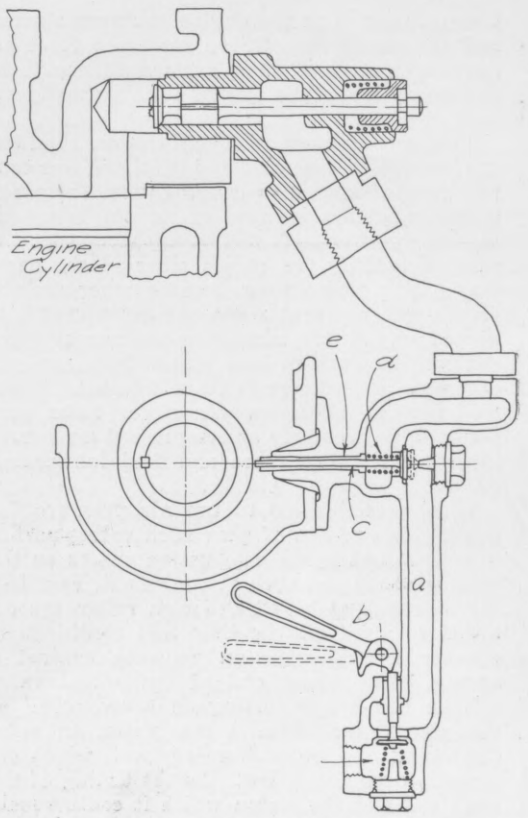

Fig. 142. *Group valves with air engagement*

the fork lifts the poppets clear of the cams.

Sometimes the forks or other devices for manually engaging and disengaging the poppet valves and their cams are dispensed with and replaced simply by the action of the starting air itself. In that case springs are used to hold the valves open and out of contact with their cams, as shown in Fig. 142. Air admitted to the valve chest *a* by means of a manually operated master valve *b* forces all the valves *c*, under which no cams happen to be situated, on to their seats in opposition to the spring force. The one which finds a cam in its way is held open while the air streams past it on its way to the check valve in the cylinder. The engine then turns and rhythmically operates the various poppet valves (only one of which appears in the sketch) in opposition to the starting air pressure tending to shut

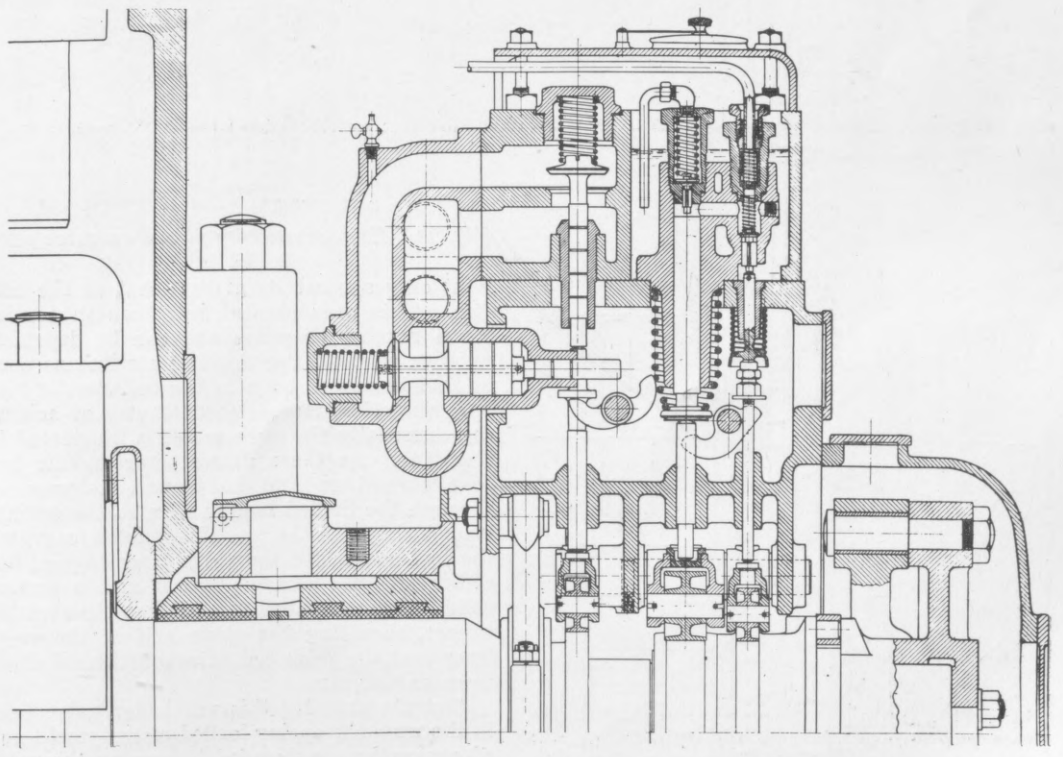

Fig. 141. *Starting valves grouped together in a chest conveniently located*

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them. As soon as the engine has been started and the air turned off, the springs *d* force all the valves clear of their cams and keep them stationary while the engine runs normally on fuel.

This arrangement, although simpler than the one previously described and involving less control mechanism, is considered unsuitable for larger machines because of its not being altogether positive. It will be apparent that the springs holding the valves clear of the cams may not be very strong, because otherwise the valves will not seat when the air pressure is turned on. At the same time the poppet valve stems must work in long lapped bushings *e* if excessive air leakage is to be avoided. Their tendency to stick, is, therefore, quite pronounced, particularly as compressed air nearly always carries moisture and foul lubricating oil.

It is possible also to use air pressure for putting in and out of gear such valves as are directly fitted to the combustion spaces on the cylinders. In one such arrangement, Fig. 143, the starting push rod and cam roller are allowed to work all the time and continuously operate a hollow piston working against a spring. The upper end of the actual valve spindle has a nut resting on a cross-wall of the piston and permits the piston to move downward and away from the nut, which ordinarily does not follow. As the timing of the push rod and the piston which it continuously moves up and down against the spring is normal and therefore depresses the piston only when the cylinder pressure is high, there is ordinarily no tendency for the valve to partake of the motion; it remains shut while the piston moves idly along its stem.

As soon as starting air is turned on there is a strong tendency for the valve to be blown inwards, but this can only occur when two conditions are simultaneously fulfilled. The first of these is that the piston which otherwise blocks the nut on the end of the valve stem must get out of the way and the second is that the pressure in the engine cylinder must be less than that of the starting air pressure acting on the valve. Then the valve follows the motion of the piston until the full-open position is reached and is drawn back to its closed position when the spring forces the whole combination up again while the cam roller at the end of the push rod rolls off its cam. The cam roller clearance is such as to make the spring force react through the nut and stem against the valve cage seat.

This valve is practically proof against sticking open, even if the spring should break. The chances for its sticking shut are slight because the continuous motion of the piston prevents the accumulation of deposits around the upper part of the stem while the four webbed guides lower down offer too little surface for them to collect. At the same time, the force of the unbalanced air pressure available for operating the valve is large. Packing, to prevent the escape of compressed air to the outside atmosphere, is needed only on the piston member which is continuously actuated and therefore highly immune against sticking. The valve itself, which is operated now and then by pressure difference needs to make a tight joint only against its ground seat at the bottom. This arrangement has been in service for a number of years and can be depended upon to shut off the starting air line as soon as fuel begins to burn in the cylinder.

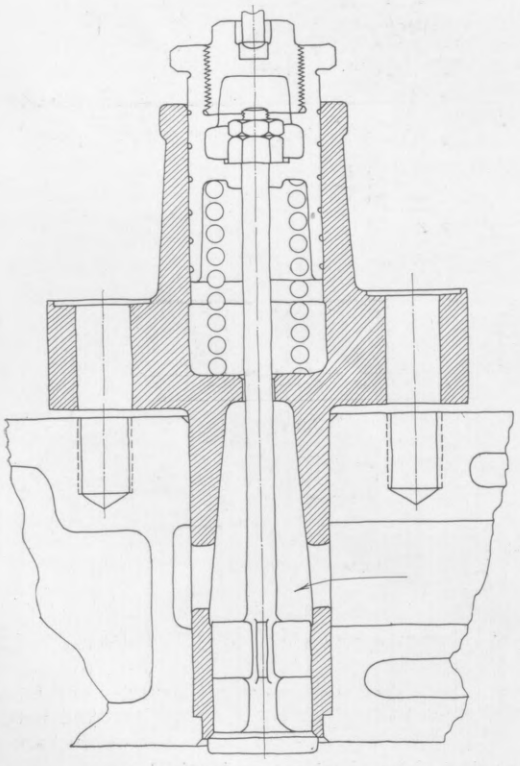

Fig. 143. *Valve with uninterrupted cam drive*

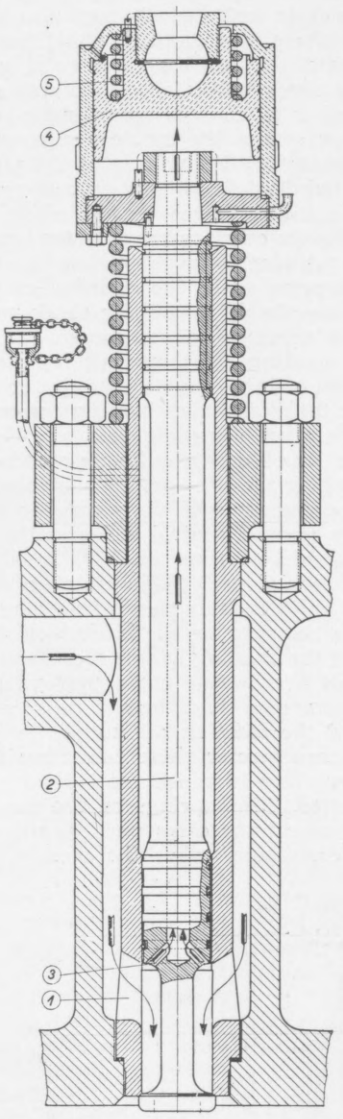

Fig. 144. *Engagement by piston on valve stem*

A somewhat more elaborate way of achieving essentially the same result is illustrated in Fig. 144. As there drawn, starting air has been turned on and has found its way up through the drilled hollow stem to the spring-loaded piston at the top. The piston, carrying the ball socket for the valve lever tappet, has compressed the spring above it and is resting solidly against a shoulder. It has elevated the tappet, thrusting the other end of the valve lever and the push rod attached thereto down towards the cam.

Had the cam for this particular valve been in the way, the spring-loaded piston would not, of course, have succeeded in moving the valve lever. Instead, the cylinder surrounding the piston would have been forced down, carrying

Fig. 145. *Bent by high pressure from faulty starting valve*

the valve spindle with it. As the engine then begins to move under the influence of the starting air impulse which has entered, the cam operates the elongated valve spindle up and down, just as though it were a rigid bar of metal. The large spring outside the stem guide meanwhile functions normally. When the air is turned off and the line vented, the small inside spring thrusts the piston with its tappet down again, raising the other end of the valve lever and clearing the roller off its cam. This valve, too, will fail to open if the pressure inside the cylinder is too great and will automatically shut (compressing the air under the piston) if the cylinder pressure should begin to rise for any reason.

All such valves should be tested after prolonged disuse to insure that they have not rusted or otherwise stuck fast. If a ship has been at sea for 20 days or more running on fuel without interruptions for maneuvering there is a possibility that the air maneuvering gear may get stuck. Just before reaching port the ship may run into a fog, sighting a cluster of fishing boats dead ahead shortly after. The signal for full speed astern may then be difficult to obey if the spring loaded piston takes it into its head to stay where it is instead of rising in response to the air pressure. To guard against this it is advisable to pry the starting valve levers up every 4 days or so and thus keep the pistons free and have it in the engine-room log that they are free. The prying up will of course make the cams strike the rollers and momentarily thrust back the hand of the man wielding the pry, but there is no danger of opening the valve against the cylinder pressure.

If a starting valve should ever be open at the time when combustion is taking place in the cylinder, the consequences may be serious, as indicated by the bent connecting rod shown in Fig. 145, the condition of which was brought about directly by the failure of a starting valve to shut promptly. After the engine had been given a good start it "hung" open during the rest of the expansion stroke and all of the suction stroke, shutting only after the piston had started on its way up at the beginning of the compression stroke. The cylinder was therefore initially filled with air having a pressure above 100 lb. per sq. in. and as the compression ratio of a Diesel cylinder is more than 30:1, it is safe to say that the piston never reached the top dead center, notwithstanding the fact that the crank went over the top under the momentum of the flywheel.

Experiences like these have impelled some designers to take great pains in designing starting valves in such a way as to make them shut by positive mechanical force, rather than relying on spring pressure. An example of such a valve is sketched diagrammatically in Fig. 146; it depends fundamentally on the action of a negative instead of the usual positive cam. Air entering at *a* passes through the drilled hole *c* and gets on top of the piston

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e, which is forced down, taking up the clearance f. The pressure thus exerted on the lever k causes it to ride hard on the cam u at the point m, but the valve b is not moved because its upper stem is free to slide in the piston at s and because liberal clearance is provided at g. Had the cam gap v-l been under the roller the clearance g would have been taken up and the piston e would have caused the valve to open. Now as the engine revolves and brings the high cam portion u against the roller it raises the lever arm k and with it the piston e. The latter, assisted by the valve spring, raises the spindle by means of the two jam nuts at the top, causing the valve to shut. Clearances at m and g allow the spring force to be taken up by the contact of the valve against its seat.

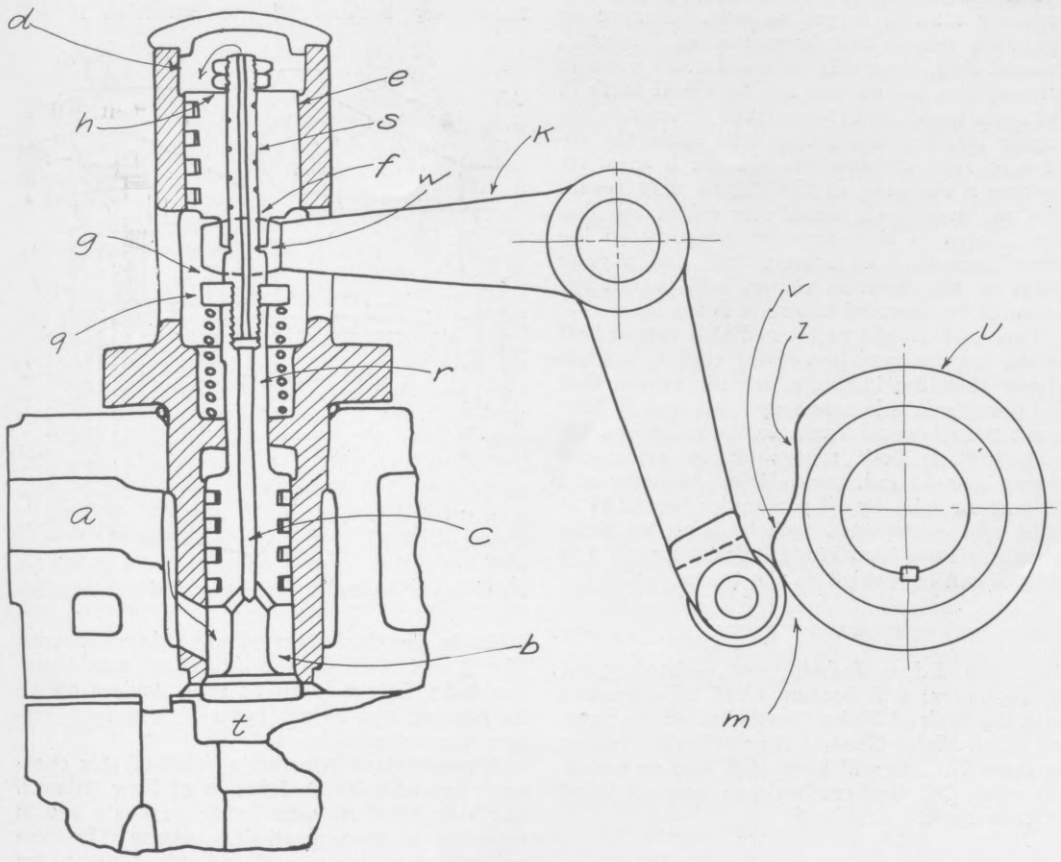

Fig. 146. *Starting valve opened by air pressure and returned by positive mechanical motion*

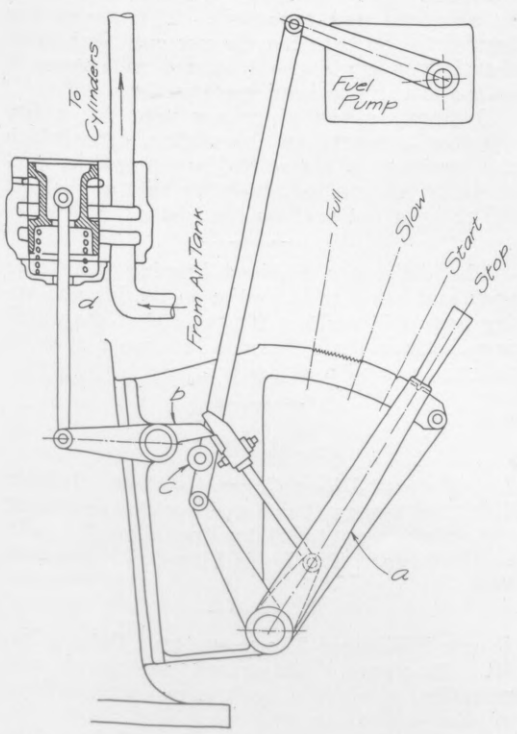

Fig. 147. *Starting control with air cut-out*

Outside of having starting valves stick fast, engineers have dreaded the effect of flame striking back into the starting air line, for reasons already mentioned. Fig. 147 shows a control lever a used for controlling both air and fuel. Through suitable linkage it affects the fuel pump in such a way that no oil is delivered during the early part of the lever's travel, this being devoted to the air starting operation. Bringing the lever back into the "stop" position allows the latch-rod to engage a pawl connected to a large relay valve in the starting air line leading to the cylinders; when the pawl is moved it opens a piston valve d connecting the starting air tank with valves of the kind shown in Figs. 143 or 144. The latter causes air pressure to actuate the starting valves on the cylinders as already described. But as soon as the lever is moved further than the "start" position the latch-rod rides up on the roller c and drops the pawl, the return motion of which shuts the piston valve d along with the starting valves on the cylinders. At the same instant the lever moves the fuel pump gear far enough to make it commence to deliver fuel, the time required for the transition being so short that the engine loses little or no momentum before the first ignition takes place. By that time, of course, all the starting valves are shut and eliminate the danger of a flare-back into the combustion line.

Other engineers, however, insist that the above-described precautions still do not conform to the ultimate in "safety first" so long as the fuel valve remains open during the starting period. One way of throwing the fuel valve out of action while starting is illustrated in Fig. 148; as a waste of injection air is automatically avoided by this system, no special provision need be made for also shutting off its supply. The particular scheme shown in the diagram depends primarily on the use of an eccentric fulcrum for the starting and fuel valve levers. As the eccentric is itself also provided with a lever, it becomes a simple matter to rotate it either manually or pneumatically in such a way that the two cam rollers are engaged and disengaged as required.

In the mid-position of the eccentric lever both fuel and starting cam rollers are clear of their cams. In order to start the engine on air it is necessary to pull the eccentric lever down into its lowest position; this increases the fuel cam roller clearance still more, while it leaves only a slight operating clearance under the starting cam roller. As soon as the engineer judges that the engine has picked up enough speed to fire safely, he rapidly moves the eccentric lever into its uppermost position, passing through the neutral position on the way. In the neutral position it is possible also to shift the cam-

(*Continued on page* 390)

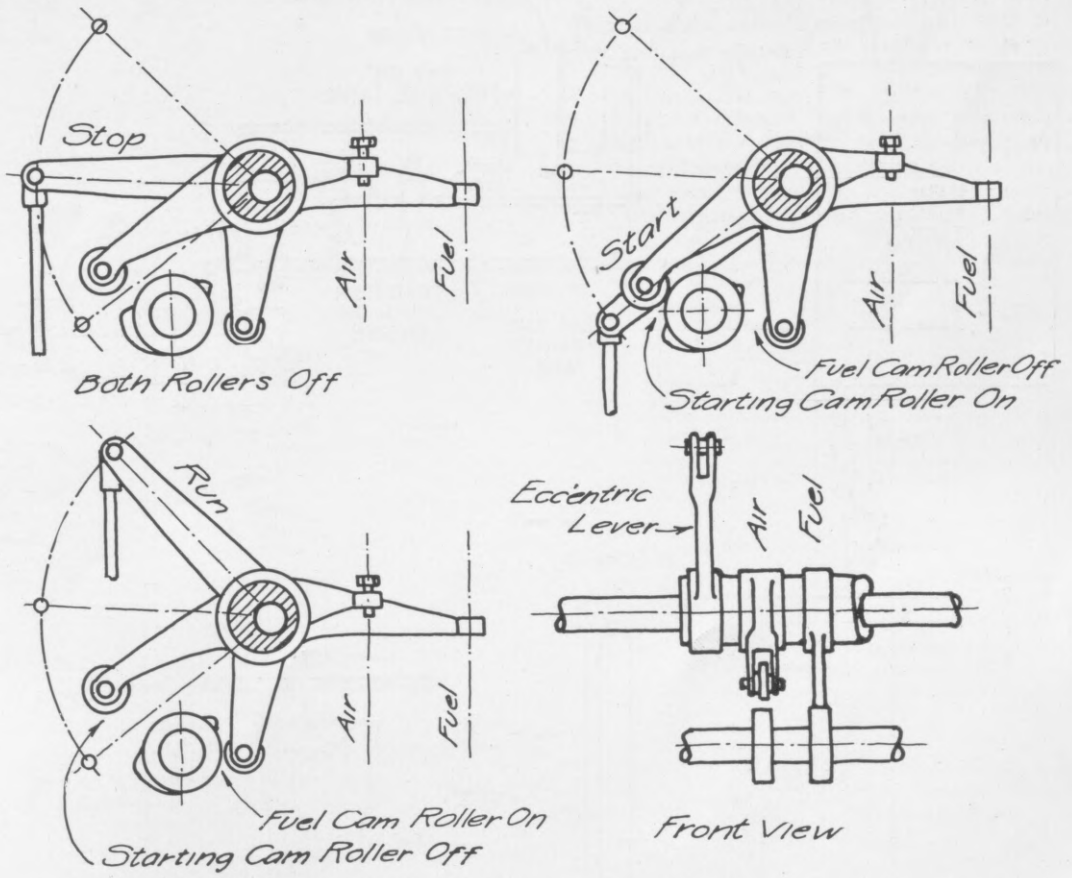

Fig. 148. *Eccentric-fulcrum levers for non-overlapping fuel and starting valve actuation*

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Fuel System for Small Boats

TO operate any Diesel or other type of oil engine successfully the fuel oil must be clean and kept under even pressure. Even the smallest particle of dirt is liable to hold open the largest valve, and where high pressure pumps are used it may cut grooves in the injection valves.

For installations of engines exceeding 500 hp. the use of centrifuges for purifying the fuel is today generally accepted as desirable practice. Even where centrifuges are employed one generally finds strainers also in use on the suction side of the fuel pumps, to entrap dirt that may enter the fuel system through the daytanks or from pipe-joints, etc.

For small craft there is no unanimity of opinion what is best. A system devised by R. A. Meyer, of San Pedro, Cal., and installed on a number of boats on the Pacific Coast, possesses good features. It is a combined purifying and even pressure system. By straining the fuel through a linen cloth or Monel metal wire cloth, 200 mesh, it is possible to get nearly all the dirt, asphalt, or other impurities, before they get to the engine fuel strainers, which should be 150 or 200 mesh. By running the oil outside of the strainer there will be little chance of the cloth blocking up, impurities and water having a chance to drop off. The area of the cloth should be not less than 12 in. by 8 in., the strainer thus being not less than 4 in. diameter and 8 in. long. A strainer of 6 in. diameter and 18 in. long will keep clean for a week, with 16 gal. per hour of 25 deg. Beaumé oil running through, provided the bottom of the tank be cleaned every 8 hours. When the day or pressure tank is full the valve No. 1 can be closed and the strainer cleaned while the engine is in operation. Monel metal cloth is not affected by acidity in oils and will not break up or deteriorate like wire cloths or brass or copper.

The purpose of the circulating system and pressure tank is to get an even pressure on the fuel pump and keep the oil "mixed." Aboard ship, especially on small craft when in a heavy sea, the oil will run back and forth in the main tanks, and if connected directly to the engine strainer and pumps will cause the engine to race or slow up. If the pumps are leaking a stopping of the engine may result. The pressure tank, sometimes called the day tank, helps to keep an even pressure on the pump because it is always full, and a gage glass on the tank, as shown, will permit the water to be observed before it is too late.

This tank should be located at a height best suited for the operation of the engine, but not higher than the injectors, for the reason that the pump and injectors may leak, and in that event the oil would run into the cylinders. A tank that is both reasonable in price and strong is a 15 gal. tank, 15 in. diameter and 21 in. long, sold by oil companies for $2.25 to $2.50 and contributed free by some oil firms when one buys high-grade lubricating oil. The fittings can be welded on the tanks.

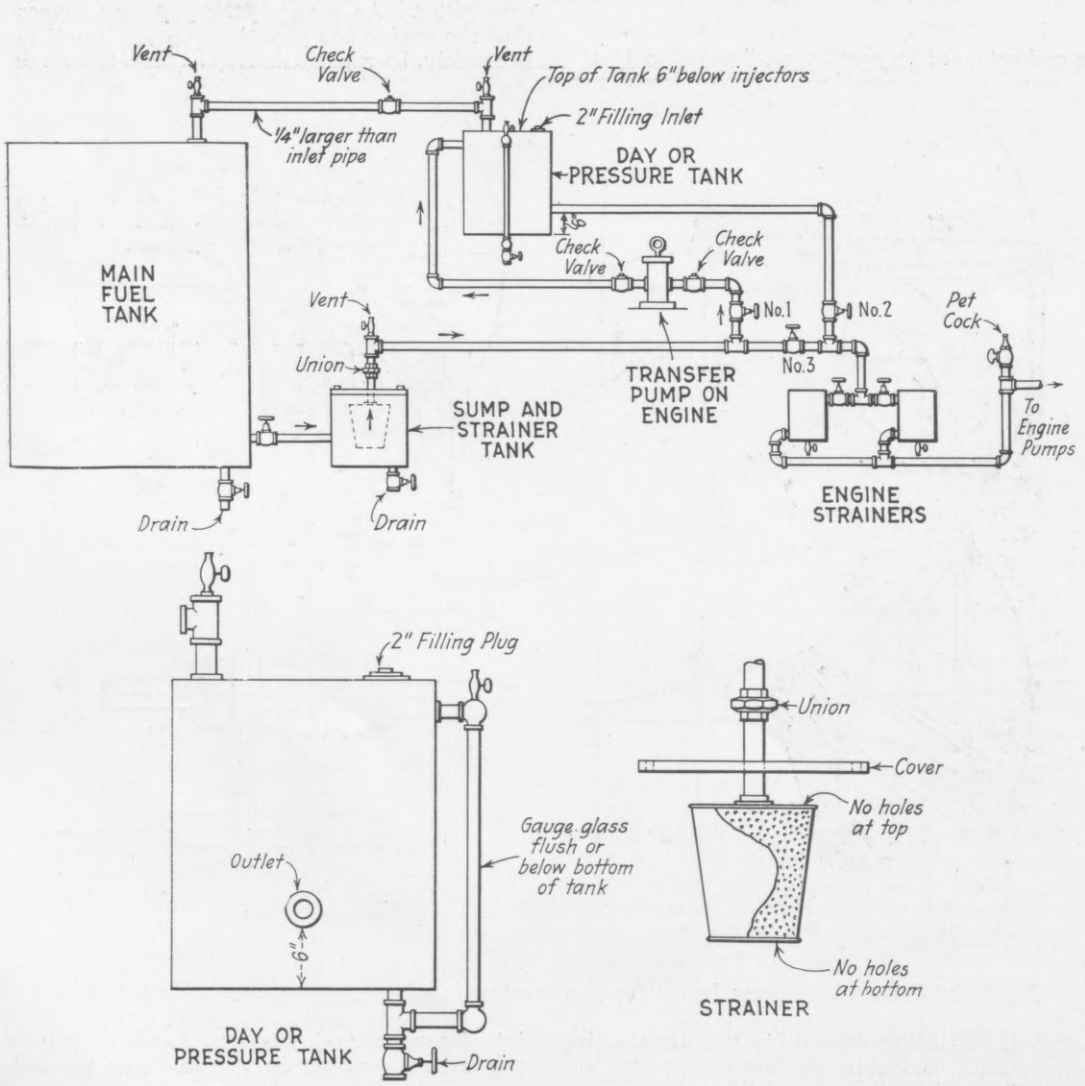

Diagram of combined purifying and fuel pressure system for small oil engine installations

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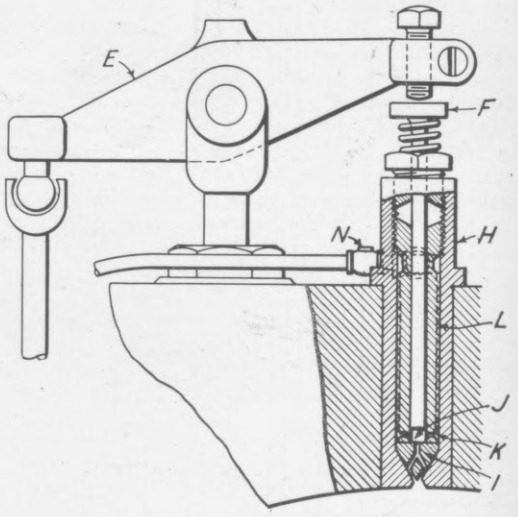
Brig.-Gen. Edgar Jadwin, now assistant chief of engineers, will become chief of engineers with the rank of Major General when the present chief, Major General Harry Taylor, retires on June 27. He will have with him as assistant chief, Col. Herbert Deakyne, now stationed at New York.

Converting Gas Engines

There have been several devices marketed during the last few years for the conversion of marine gasoline engines to the consumption of light fuel oil. A device of this character that can be demonstrated to furnish satisfactory engine service over a long period of time will meet with widespread acceptance because of the reduction it will make in the fuel item of operating expenses. The Coast Guard, for instance, would undoubtedly be ready to fit such devices on all its gas-engined patrol boats if a proved pattern were available.



Fuel injection valve for converted gas engines

A mechanical injection system of this character invented by P. Johnsen of New Orleans, has been tried in some southern boats and is reported to give promising results. It comprises a fuel valve and individual pump for each cylinder. The pump is located under the cam that operates the push rod of the fuel valve and is operated by it. The pressure stroke of the pump feeds the oil through the check valve *N* into the fuel valve casing *H*, where it passes down parallel grooves *L* and through ports *K* into the fuel chamber *J*. When the valve rocker *E* is actuated by its push rod and sharp cam it gives a quick blow to the head *F*, forcing the fuel plunger rapidly downwards and thus injecting the oil through the orifices *I* into the combustion chamber. The fuel spray is stated to be highly atomized and turbulent. This device has been fitted on both 2-cycle gas engines and on 4-cycle gas engines. On the 4-cycle types it calls for valve-in-head construction.

Ordinary spark plugs are used for a few minutes to warm up the engine, after which the ignition is stated to be automatic, presumably being aided either by heat at the fuel tip or by a hot spot on the piston.

The difference between keeping your eyes open and being wide awake on the job and being dopy and wishing for the end of the watch is sometimes the difference between a successful voyage and a shipwreck.

Catalogs

L-A Motors—Direct Current motors. Bulletin 226. An 8-page illustrated booklet describing D.C. motors up to 20 hp. including the fully enclosed type. The Louis Allis Co., Milwaukee, Wis.

Brown Resistance Thermometers. Catalog No. 92. 20 pages. Illustrated description and price-list of electric resistance thermometers, of the indicating and recording types, for temperatures up to 1000 deg. Fahr. The Brown Institute Co., Philadelphia, Pa.

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Distinctive Colors for Pipes

AMONG the new standards approved by the American Marine Standards Committee, and copies of which will be distributed as soon as practicable, is the schedule of distinctive colors for piping. Details are set out in the diagram on this page. The purpose of the distinctive colors is to render the use of any particular pipes in any vessel clearly and immediately apparent to anyone not familiar with the ship or engine installation. An engineer newly signed on will be greatly benefited by the distinctive coloring system and any engineer, no matter how familiar with his installation, will also be helped thereby, particularly in connection with the pipes and valves that are used only occasionally.

The system of distinctive coloring has been used in the American Navy for a long time and probably in other navies also. It is also common on oil tankers. It has not yet come into general use because there has been no recognized standard, and many of those who have been favorably inclined towards the system have been reluctant to introduce their own standards. It now becomes possible for owners of vessels to adopt a fixed American Standard. Owners of towboats, ferries, fishing boats and smaller vessels built in yards where no drawing office is maintained can now quite as easily have the distinctive coloring system for pipes incorporated in their new construction, as the owners of vessels who can maintain a big marine technical department of their own.

The application of the standards is advised only in connection with pipes the use of which is not obvious. On the engine itself, for instance, there is seldom need to mark distinctively the fuel pipes, lubricating oil pipes, water pipes, etc. Where, however, the pipes emerge from the bilges, or pass through bulkheads or are of considerable length and their use is not immediately obvious, the distinctive markings are advisable.

The Marine Standards Committee suggests that the pipes be marked at intervals as for instance, on the edges of flanges adjacent to valves and at such other flanges as may be deemed useful for convenient identification of the pipe. Bands of distinctive coloring can also usefully be made on both sides of the valves or flanges.

American Marine Standards

In addition to the standard for distinctive colors the American Marine Standards Committee has also approved kinds and sizes of hose for ship equipment, specifications for ¾ in. and 2 in. flexible metallic hose, for 2½ in. double jacketed cotton rubber lined fire hose, 2½ in. unlined linen fire hose, operation, care and upkeep of Scotch type marine boilers, kinds and sizes of mattresses and pillows and woolen and cotton articles for ship equipment, kinds and sizes of glassware and kinds and sizes of silverware.

Personal

Harlan A. Pratt has been appointed manager of the oil and gas engine department of the Ingersoll-Rand Co. Mr. Pratt, who is a graduate of Stevens Institute of Technology and a former director of the American Institute of Electrical Engineers, was connected for many years with the sales department of the Westinghouse Electric & Manufacturing Co. Later he became sales manager of the Atlantic Elevator Co., exclusive agents in the East for Westinghouse gearless direction elevators, and for three years has been sales manager of the Elevator Supplies Co. of Hoboken, N. J.

L. J. Galbreath has joined the American Brown Boveri Electric Corp. to take charge of publicity and sales promotion in the capacity of assistant to Earl G. Hines, recently appointed general sales manager of that company. Since graduation from Cornell University in 1917 Mr. Galbreath has served in executive and publicity capacities with the Niles-Bement Pond Co., the Columbia Machine Works, the Malleable Iron Co. of Brooklyn, and most recently with the Bridgeport Brass Co.

E. O. Shreve, manager of the San Francisco office of the General Electric Co. since 1918, has been named manager of the industrial department of the company at Schenectady, to fill the vacancy caused by the recent death of A. R. Bush.

G. H. Froebel, formerly manager of the marine department of the Westinghouse Electric & Manufacturing Co., has been appointed central station manager of the Westinghouse sales department.

NOTE. In the sketches shown below (left-hand column only) the flanges should be painted black on all supply or suction piping and should be colored red on all delivery or exhaust piping.

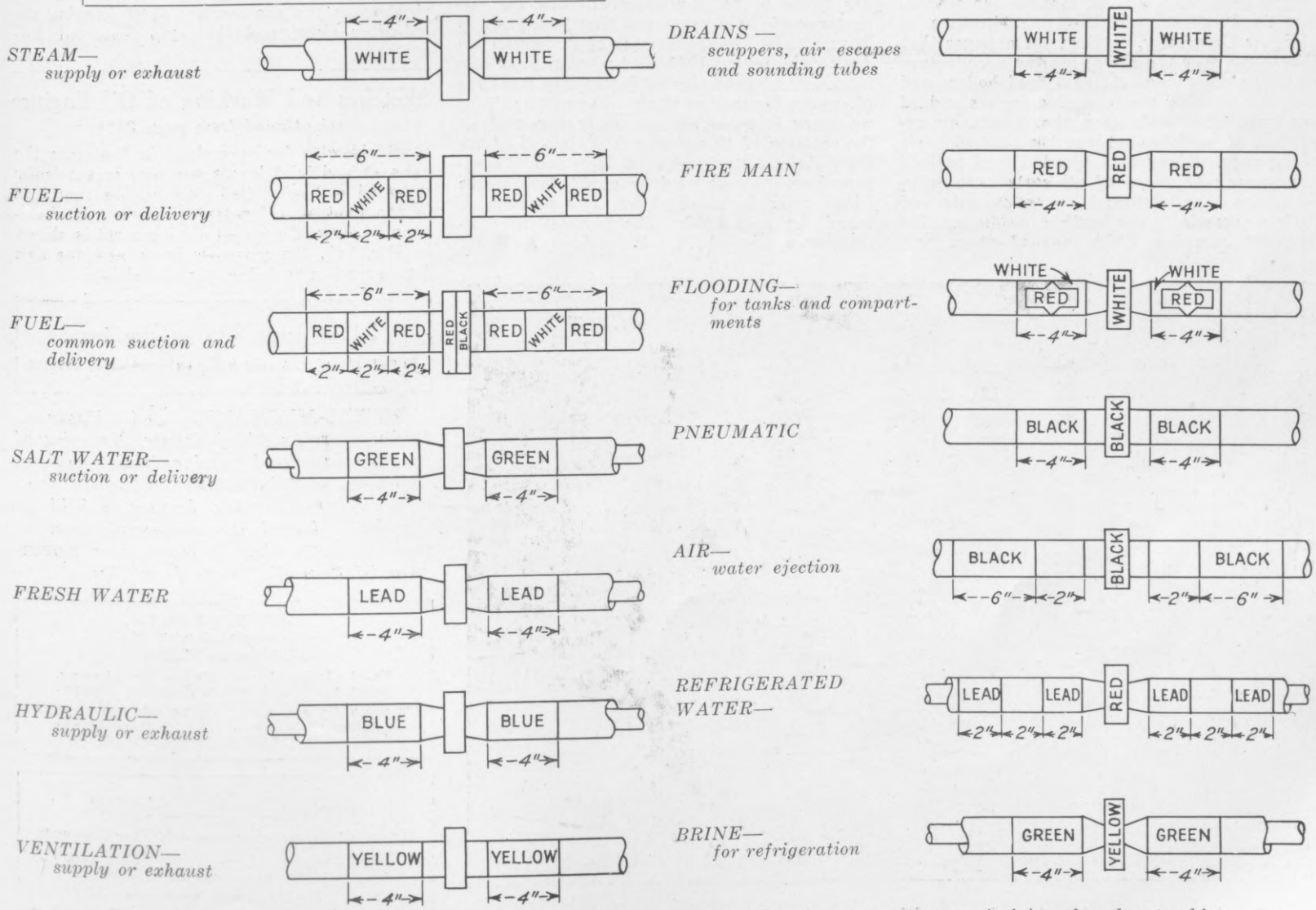

Diagram of colors adopted by American Marine Standards Committee for the ready identification of piping aboard motorships

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Recent Technical Reports and Addresses

A Review of the Principal Monographs on Motorships, Marine Oil Engines and Associated Subjects

What is Sea-Speed?

By R. J. Eyres. Published by the North East Coast Institution of Engineers and Shipbuilders, Newcastle, England.

Apparently the author of this paper hoped to furnish data and submit considerations that might be used in the formulation of a measurement of sea speed, but actually he succeeded only in showing once again how impossible it is to take account of all the variables that influence a ship's speed at sea. Sea-speed is a term which some shipowners like to work into a contract, but it deserves no place there. It expresses the hope of the shipowner that his vessel may keep her fair weather speed independent of the influences of weather, tide, poor navigation, careless steering, foul bottom, machinery defects and the human element. On the other hand, it expresses the shipbuilder's hope for a fair break of luck. At the time the contract is written the two parties have different things in mind even though they use the same term, "sea speed." A positive measure of it or a definition enabling it to be calculated from a year's operation is not possible. "Sea-speed" is a variable and always will be.

Modern Ship Design

By Percy A. Hillhouse, D.Sc. Published by the Greenock Philosophical Society, Glasgow, Scotland.

In a broad and general manner the author, who is Professor of Naval Architecture at Glasgow University, outlines the changes that have come over the art of marine architecture since the days when the coal fired boilers and the reciprocating steam engine were standard and invariable and when the Admiralty coefficient of performance was the nearest guide to the prognostication of speed. Diesel engines and steam variations of all sorts have revolutionized the internal arrangements of modern vessels. The author compares the AORANGI carrying 4,000 tons of cargo and fuel oil for a round voyage of 15,000 miles with her predecessor of 25 years ago carrying half the cargo and fuel for one passage only. Machinery and fuel for the round voyage weigh 5000 tons less than would have been necessary in 1900. Similarly, publication of test tank results has transformed hull design, usable data being available for practically every ordinary type of form or proportion. Professor Hillhouse also pays a high compliment to the great assistance furnished by modern magazines of the MOTORSHIP type. During the last 25 years also the classification societies have pushed steadily forward towards the goals of simplicity and efficiency in structural design, the most important feature of progress having been the incorporation of the superstructures as the top member of the main strength girder in such a way as to avoid an excessive ratio of length to depth. An illuminating comparison between certain features of passenger liners of 25 years ago and those of today and some sketches of modern cabin lay-outs conclude this address, which formed the James Watt Anniversary lecture of the Greenock Philosophical Society.

The Development of the Nobel Engine

By P. H. Dixon Wilson. Published by the Institution of Engineers and Shipbuilders in Scotland, Glasgow, Scotland.

Those who have first made contact with Diesel engines only during the past few years are likely to be unacquainted with the importance of the development that took place in Russia under the sponsorship of Ludwig Nobel during the period 1897-1907 when nobody else in the world gave sign of interest in this type of engine for marine work. The motorship as we know it today, is commonly regarded as the creation of Burmeister & Wain and of the East Asiatic Company. Sulzer and Werkspoor have also been given credit for marine Diesel activities at about the same period, say round the year 1910. The inspiration, however, was all Nobel's. Burmeister & Wain, Sulzer and Werkspoor were stimulated to activity by the Nobel development. The Nobel family did the pioneering. The earliest of this work and the later developments in Russia, until the revolution there robbed the Nobels of all their possessions, is well outlined by Mr. Wilson, and we use the term "well outlined" because we judge it in the light of our own familiarity with that early work, having studied it in Russia long before the western world really knew what a motorship was. Mr. Wilson then reviews the Nobel development as it was advanced in Sweden where Ludwig Nobel collected his staff after the revolution and resumed operations. The Nobel 2-cycle design of today is notable for its efficiency. It has been fully described in MOTORSHIP. Mr. Wilson shows it in the form in which it is built by Mirrless, Bickerton & Day, in England, themselves builders of Diesel engines for 30 years and now adherents of the Nobel design for engines above 800 b.hp.

A piece of machinery which is always abused seldom works well, but that is no argument against it.

Sometimes the remedy is worse that the disease, but who wants to keep the disease?

When we find that one system does not work it is time to devise a new system.

Keep the fire extinguishers filled and in place.

Don't be too sure the engine is **not** working right when you are careless about keeping the indicator clean and then **get distorted diagrams.**

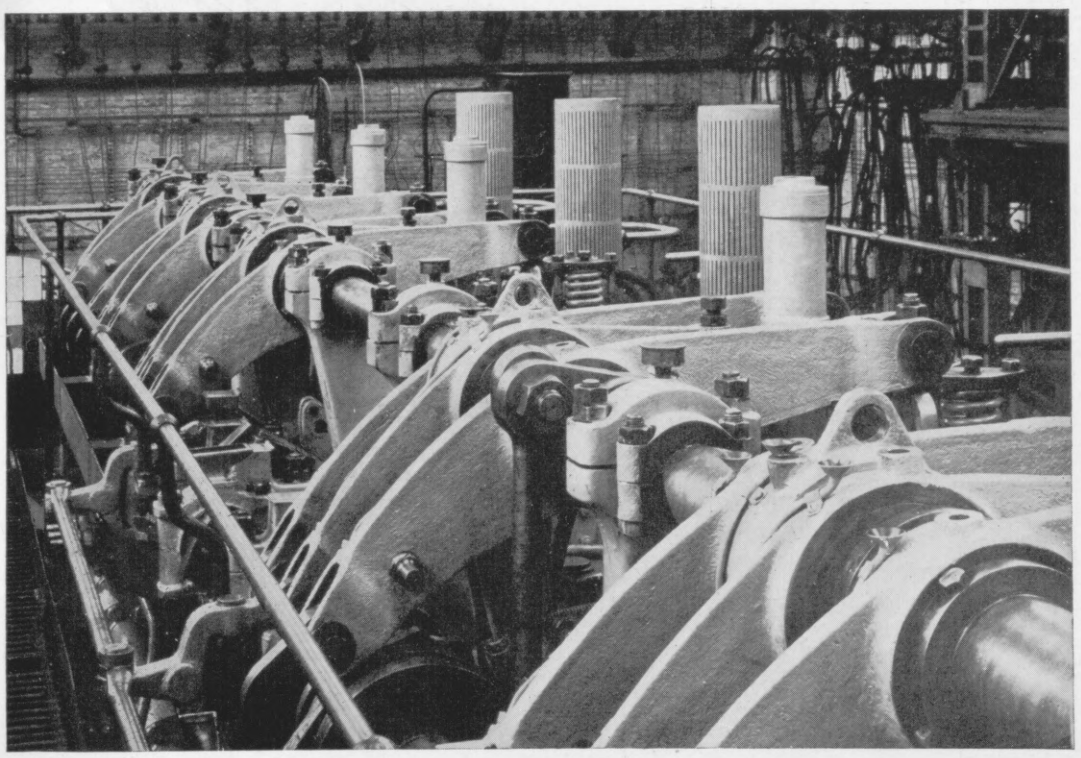

Fig. 149. *Arrangement of rocking levers with eccentric fulcrums on a marine type oil engine*

Sketches and Working of Oil Engines

(*Continued from page* 387)

shaft sidewise for reversing; in that case the exhaust and inlet levers are also eccentrically mounted and are lifted clear of the cam tops in the neutral or central position. A photographic view of such an arrangement is shown in Fig. 149, the eccentric lever and the link for operating it being plainly visible.

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